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CONTRIBUTIONS TO THE STRATIGRAPHY OF THE ALLEGHENY SERIES IN COLUMBIANA AND MAHONING COUNTIES, OHIO

PART II. THE STRATIGRAPHY OF THE MIDDLE KITTANNING COAL BETWEEN GREENFORD AND WASHINGTONVILLE, OHIO

MYRON T. STURGEON,
Michigan State Normal College,
Ypsilanti, Michigan

The Kopp Klay Kompany has a small plant for the manufacture of building tile at Greenford in Green Township, Mahoning County, Ohio. This plant is located about 0.6 of a mile east of the Greenford square on the south side of the road and on the west side of the Niles and Lisbon branch of the Erie Railroad. (See Figure 1.)

Formerly the clay used for making the tile came from a now abandoned mine at the plant. This mine, which was opened many years ago by Andrew Reichstadt, will be herein called the Reichstadt mine. It has long been a matter of dispute among geologists and local miners whether the clay used in this tile plant is the underclay of the Lower of Middle Kittanning coal. Some believe that it is the Lower Kittanning clay, others are equally certain that it is the Middle Kittanning clay; and still others are uncertain as to which of the Kittanning clays it is.

I talked recently with a son of Andrew Reichstadt who was able to tell me that the mine was opened about 75 years ago but was unable to give me much information concerning the mine. The oldest possible written mention of this mine and at that a very uncertain one was made in 1878 by Newberry, who wrote as follows:[1]

"In the east part of the Township (Green), Coal No. 4 has been opened on the farms of Reichstahl and Roller but is not now worked."

It is entirely possible that Newberry misspelled the name Reichstadt and that the location mentioned is the mine in question, but the different spelling of the name and the uncertainty of the exact location are only suggestive at best. Newberry's Coal No. 4 is now known to be the Middle Kittanning coal in this vicinity.

Orton was the next geologist to visit the locality under consideration, and there is no question that the Reichstadt mine was in operation at that time. He wrote as follows:[2]

"A mile and a half south . . . at Green Station, the Lower Kittanning coal makes its first appearance. . . . It has been mined here by Andrew Reichstadt on section 23. It lies about 15 feet above the railroad. . . .

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[1]Newberry, J. S.: *Report on the Geology of Mahoning County*, Geol. Surv. Ohio, Vol. III, p. 812. (1878.)

[2]Orton, Ed.: *The Stratigraphical Order of the Lower Coal Measures of Ohio*, Geol. Surv. Ohio, Vol. V, pp. 32–33. (1884.)

"The (Lower) Kittanning coal can be followed from Green Station to the southward along the valley of the Cherry Fork, without difficulty. It falls a little faster than the valley, so that at the Walters Mine, section 35, Green township, it lies about level with the railroad."

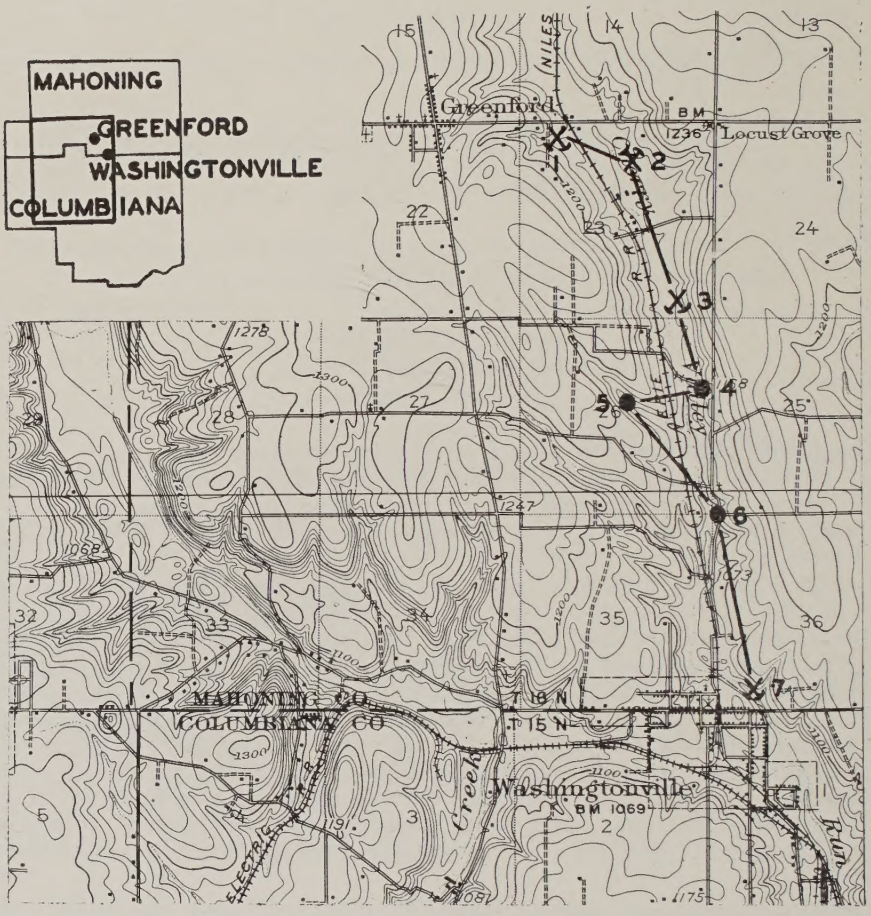

FIG. 1. Portion of the Lisbon Quadrangle showing the location of Greenford and Washingtonville and the localities at which the Middle Kittanning coal and associated strata were studied. Inset shows an outline map of Mahoning and Columbiana Counties, the area within the Lisbon Quadrangle, and the location of Greenford and Washingtonville.

1. A. Reichstadt Mine.
2. M. A. Less Mine.
3. C. J. Roller Prospect Pit.
4. M. and L. Schnurrenberger Exposure.
5. E. R. Kurtz Exposure.
6. M. Roller Exposure.
7. J. A. Stouffer Mine.

Although Orton called this coal the Lower Kittanning, three miles further south at Washingtonville the Lower Kittanning coal with which he correlated the Reichstadt coal has been shown by Stout and Lamborn to be the Middle Kittanning coal.[3]

No detailed section of this mine was published until 1923, when Stout wrote as follows:[4]

"At Greenford, Green Township, the same members are worked by the Kopp Klay Kompany for the manufacture of building block. The beds are reached by a slope. A record taken in the mine follows:

Shale
Coal, *Lower Kittanning*.....2′ 3″
Clay, light, lower part siliceous, *Lower Kittanning*.....7′ 0″
Shale, siliceous.

"The thickness of the clay varies from 6 to 8 feet, but averages about 7 feet. The overlying coal is of fair quality and is used in manufacturing the clay into ware. The clay is above drainage along the main valleys in the southern part of the county, but owing to the thick covering of drift it is seldom well exposed for measurement. The quantity of material available, however, appears to be large."

Lamborn gives an almost identical section in a recent report.[5]

As can readily be seen from reading the above there have been different opinions of the correlation of the coal and clay in the Reichstadt mine. Orton and possibly Newberry believed them to be the Middle Kittanning members, and more recently Stout and Lamborn have identified them as the Lower Kittanning members. The mine is now abandoned and cannot be restudied at present.

In 1939 I visited a new mine which had been opened at approximately the same level and presumably on the same coal and clay almost directly across the valley on the east side of Cherry Valley Run on the Mary A. Less farm in the northeast quarter, Section 23, Green Township, Mahoning County. The rocks in this new mine, herein called the Less mine, were studied at that time, and the section of the strata is as follows:

9.	Sandstone: gray, massive or bedded, fine grained, exposed, *Lower Freeport*.....		6′ 0″
8.	Shale: gray, slickensided.....		2′ 6″
7.	Shale: dark gray, pyritiferous, nodular, fossiliferous	*Washingtonville*....	0′ 5″
6.	Shale: black, bony, sparingly fossiliferous.....		1′ 6″
5.	Shale: gray, slickensided; with clay ironstone concretions.....		4′ 6″
4.	Shale: black, bony, fossiliferous.....		0′ 9″
3.	Coal: bony, resembles cannel coal.....	*Middle Kittanning*	0′ 6″
2.	Coal: with thin irregular marcasite partings.....		2′ 0″
1.	Clay: light gray with a few inches of dark clay at base of the coal at most places in the mine, plastic; with lenses of light gray, fine, compact sandstone up to 1 foot in thickness, exposed.....		10′ 0″

From a comparison of the above section with the local lithology of the Lower and Middle Kittanning coals and their associated strata it was reasonably certain that these were the Middle Kittanning coal and clay. The strata associated with the Kittanning coals in this vicinity normally have such a different lithology

[3]Stout, W., and Lamborn, R. E.: *Geology of Columbiana County*, Geol. Surv. Ohio, 4th series, Bull. 28, pp. 158–159. (1924.)

[4]Stout, W. et al.: *Coal Formation Clays of Ohio*, Geol. Surv. Ohio, 4th series, Bull 26, p. 332. (1923.)

[5]Lamborn, R. E.: *The Coal Beds in Southeastern Mahoning County*, Geol. Surv. Ohio, 4th series, Bull. 43, p. 30. (1942.)

and succession that each can be readily recognized at most places. The following is a complete and composite section illustrating the local stratigraphy of these two coals and associated strata:

17.	Sandstone, *Lower Freeport.*		
16.	Shale: gray; with clay ironstone concretions, thickness variable		6′ 0″
15.	Shale: black, bony, fossiliferous, marine, *Washingtonville*		1′ 6″
14.	Shale: dark gray; with clay ironstone concretions, thickness variable		3′ 6″
13.	Coal, *Middle Kittanning*		2′ 4″
12.	Clay: gray, plastic, siliceous		1′ 6″
11.	Limestone: gray, nodular, ferruginous, freshwater, *Salem*		1′ 0″
10.	Clay: very local, *Oak Hill*		2′ 0″
9.	Shale and (or) sandstone		30′ 0″
8.	Shale: gray, fossiliferous, marine	*Hamden*	4′ 0″
7.	Shale: gray to gray-black, fossiliferous, marine; with nodular fossiliferous limestone; locally with cone-in-cone	*Hamden*	0′ 10″
6.	Shale: black, bony, fossiliferous, brackish or marine	*Hamden*	0′ 8″
5.	Coal, *Lower Kittanning*		3′ 0″
4.	Clay: gray, plastic		2′ 6″
3.	Coal: impure, locally absent, *Lawrence*		1′ 8″
2.	Clay: gray, plastic		8′ 0″
1.	Shale and sandstone		25±′

The following features of the section in the Lees mine suggest the Middle Kittanning members:

(1) The presence of the sandstone, zone 9.
(2) The presence of the fossiliferous shale, zones 6 and 7.
(3) The presence of shale with clay ironstone concretions, zone 5.
(4) The absence of a nodular marine limestone, zone 7 in the above composite section.
(5) The absence of an impure coal in the underclay, zone 3 in the above composite section.
(6) The thickness of the coal, zones 2 and 3.

On the other hand, some of the features of the same section are indicative of the Lower Kittanning members:

(1) The presence of black, bony, fossiliferous shale immediately overlying the coal, zone 4.
(2) The presence of cannel coal on top of the bituminous coal, zone 3.
(3) The absence of the nodular freshwater limestone at the base of the Middle Kittanning underclay, zone 11 of the composite section.
(4) The thickness of the underclay, zone 1.

Unfortunately none of these evidences is positive proof of either member; for exceptions are ever the rule in the lithology and stratigraphy of the coal measures. For example, the distribution of both the Salem and Washingtonville members is irregular, and there are localities where fossils are in the layers immediately on top of the Middle Kittanning coal as occur in Section 26, Perry Township, Columbiana County and at Teegarden in Section 32, Salem Township, Columbiana County.[6] There is still another means of checking the identity of these members.

[6]Sturgeon, M. T.: *The Stratigraphy and Paleontology of the Middle Portion of the Allegheny Formation of the Lisbon (Ohio) Quadrangle,* Master's Thesis, Ohio State University, pp. 40 and 47. (1933.)

Both Kittanning coals are definitely known and were formerly extensively mined in the vicinity of Washingtonville, which is distant from the Less mine about three miles south and a little east along Cherry Valley Run. There the Lower Kittanning coal is below drainage but was seen in one mine which was in operation in 1939 on the east side of Cherry Valley Run in the southwest corner of Section 36, Green Township, Mahoning County. The old Middle Kittanning mines are abandoned, but in spite of slumped debris this coal can still be seen at several places. A small mine on the J. A. Stouffer property which is nearby to the above Lower Kittanning mine, was studied by Stout and Lamborn and is the type section of the Washingtonville shale. The Middle Kittanning coal is no

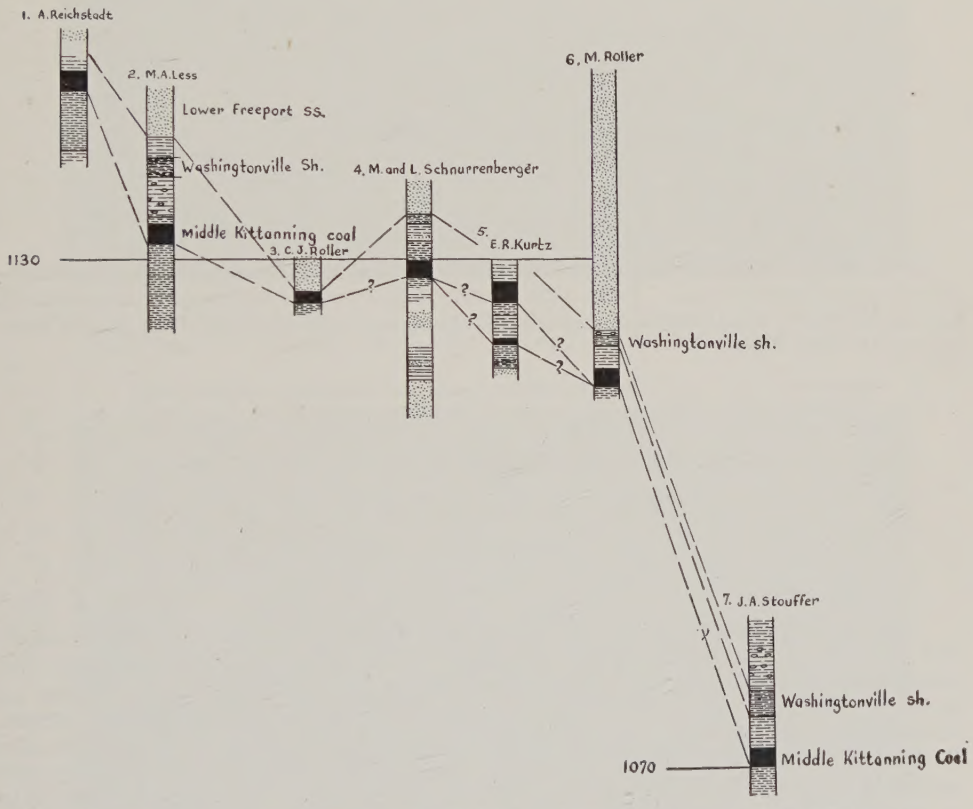

FIG. 2. Correlation diagram of the Middle Kittanning coal and associated strata between Greenford and Washingtonville, Ohio

longer exposed at the Stouffer mine, but the Washingtonville shale is still visible, and the position of the coal can easily be determined from Stout and Lamborn's published section.

Along the east side of Cherry Valley Run between the Less mine at Greenford and the J. A. Stouffer mine at Washingtonville are a number of locations where the Middle Kittanning coal can be seen or has been prospected or mined. The level of the coal can be traced with reasonable certainty from one location to another, although several of the mines and prospect pits are so covered with debris and vegetation that the strata cannot be seen. All the localities at which the Middle Kittanning coal is exposed on the east side of Cherry Valley Run between Greenford

and Washingtonville have been studied and plotted graphically in an attempt to determine the true identity of the coal and clay in the Less mine. The descriptions of these localities, all of which are in Green Township, Mahoning County, are given below. The map shown in Figure 1 illustrates the relative position and the chart shown in Figure 2 gives the lithologic and stratigraphic relationships of the above localities.

The first of these localities is at Washingtonville in the now abandoned J. A. Stouffer mine in the southwest quarter of Section 36. This is the section described by Stout and Lamborn as the type for the Washingtonville shale, and their section is quoted below.[7]

	Feet	Inches
Shale, gray	3	0
Shale, gray, with ore nodules	4	0
Shale, with two layers of iron ore	...	8
Shale, gray	...	8
Shale, bony, carbonaceous, fossiliferous, *Washingtonville*	3	0
Shale, dark, fissile, siliceous	3	8
Coal, *Middle Kittanning*	2	4
Clay, siliceous	3	0

The next exposure is about a mile north of Washingtonville along the Washingtonville-Canfield road. Here just south of the old schoolhouse in Section 25 this north-south road was changed several years ago, and the following strata were exposed: (See Figure 3.)

6. Sandstone: light gray, fine, micaceous, cross and irregularly bedded; with streaks of coal, plant fossils and clay ironstone concretions, base irregular, exposed, *Lower Freeport*	30′	0″
5. Shale: dark gray; with numerous small clay ironstone nodules	0′	6″
4. Shale: black, bony, sparingly fossiliferous, *Washingtonville*	1′	1″
3. Shale: light gray	2′	8″
2. Coal, *Middle Kittanning*	2′	2″
1. Clay: light gray, plastic, exposed	1′	0″

This section, herein called the M. Roller section, is no longer well exposed, and the top of the Middle Kittanning coal which was formerly exposed on the east side of the road opposite the May Roller farm buildings cannot be seen at present. However, the coal rises rather sharply to the northward toward the old schoolhouse, and from the now covered exposure in the roadside ditch opposite the Roller buildings it rises 21 feet in a distance of 500 feet toward the schoolhouse, and at that point the Middle Kittanning coal can still be dug out on the east side of and just above the road level.

The Washingtonville shale is well exposed and typical in lithology but only sparingly fossiliferous. The other associated strata are thinner than at Washingtonville but the principal difference is the presence of the base of the Lower Freeport sandstone only a little over four feet above the top of the Middle Kittanning coal.

The next exposure is about 0.6 of a mile further north on the west side of the Washingtonville-Canfield road. Here a road formerly joined the north-south road from the west at an elevation of 1168. The exposure, herein called the Schnurrenberger section, is in a small ravine that parallels the abandoned road and leads westward to Cherry Valley Run:

[7]Stout, W. and Lamborn, R. E.: *Op. cit.*, pp. 159 and 177. (1924.)

FIG. 3. A. Lower Freeport sandstone and Washingtonville shale (at hammer) on east side of Washingtonville-Canfield road opposite M. Roller farm buildings.

FIG. 3. B. Lower Freeport sandstone and Middle Kittanning coal (at arrow) in prospect pit on C. J. Roller farm.

8.	Sandstone: gray, thin-bedded, fine, friable, exposed, *Lower Freeport*.....		3′ 6″
7.	Clay: gray-buff, plastic.....		1′ 0″
6.	Shale: gray-buff, soft but arenaceous; with 5-inch layer of sandstone near base.....		2′ 0″
5.	Clay: with dark shaly layers.....		2′ 4″
4.	Coal: shaly.....	*Middle Kittanning*	0′ 5″
3.	Coal: good.....		1′ 6″
2.	Clay, shale and sandstone: this is largely a covered interval.....		12′ 0″
1.	Sandstone: gray, medium, massive, friable; with some plant fossils, exposed.....		4′ 0″

The elevation of the Middle Kittanning coal is 1128 here, and at the M. Roller section the same coal varies from 1115 to 1136. This section is a little unusual in the clay or clay-shale above the coal and in the absence of the Washingtonville shale. Almost due west of this on the west side of Cherry Valley Run on the E. R. Kurtz farm in the north-central part of Section 26 is the following section:[8]

8.	Shale: gray-black, weathered, exposed.....	2′ 0″
7.	Coal, *Middle Kittanning*.....	2′ 3″
6.	Clay: gray, plastic, carbonaceous.....	1′ 7″
5.	Shale: gray-black, carbonaceous, siliceous.....	2′ 9″
4.	Coal.....	0′ 4½″
3.	Coal: shaly.....	0′ 5″
2.	Clay: gray, plastic; with a 6-inch layer of clay ironstone concretions one foot above the base, *Salem?*.....	2′ 8″
1.	Sandstone at creek level.	

Here the elevation is between 1120 and 1130. This exposure which is only about one-half mile southwest of the Schnurrenberger exposure suggests an alternative interpretation to that section. The coal called the Middle Kittanning coal in the Schnurrenberger section may be the lower coal, zones 3 and 4, on the Kurtz farm. If this interpretation is the true one, then it is probable that the Lower Freeport sandstone displaces both the Washingtonville shale and the Middle Kittanning coal at the 1168 road intersection and the plastic clay overlying the coal in that section is really the Middle Kittanning underclay. Also if that is the case, then the coal in the Schnurrenberger section and the lower coal in the Kurtz section probably are the local coal (Strasburg) above the Oak Hill clay. The Oak Hill member belongs in the interval between the Salem and Hamden members and is absent at most places in this vicinity.

In the wood lot on the east side of Cherry Valley Run on the C. J. Roller farm in the southeast quarter of Section 23, the Middle Kittanning coal has been prospected and the section of the exposed strata is as follows: (See Figure 3.)

3.	Sandstone: gray-buff, bedded, micaceous, exposed, *Lower Freeport*.....	4′ 0″
2.	Coal, *Middle Kittanning*.....	1′ 6″
1.	Clay: gray-buff, plastic, exposed.....	1′ 0″

The approximate elevation of the Middle Kittanning coal here is 1125. The base of the Lower Freeport sandstone rests directly upon the Middle Kittanning coal, and this relationship probably accounts for the thinness of the latter member. Along this slope the position of the base of the Lower Freeport sandstone and

[8]Sturgeon, M. T.: *Op. cit.*, pp. 38–39.

presumably the position of the Middle Kittanning coal is marked by several springs, and a half mile further north at the C. J. Roller buildings there is an abandoned mine. The coal is no longer visible, but several feet of thickness of the Lower Freeport member can be seen. The elevation of the coal here is approximately 1120. It is less than half a mile from the C. J. Roller buildings to the Less mine from which the clay is taken at present for the Kopp Tile plant and which was described previously in this report. The elevation of the Middle Kittanning coal in the Less mine is probably between 1130 and 1135. In the two ravines between the C. J. Roller farm buildings and the Less mine the Lower Freeport sandstone is well exposed with an exposed thickness of about 75 feet.

From the available evidence in the field the uncertain coal and clay in the Less mine can be traced along the east side of Cherry Valley Run without reasonable doubt into the certain Middle Kittanning members at Washingtonville. This is evident not only from similar elevations but also from similar lithology as is shown in Figure 2. There is a sharp drop in the elevation of the coal between the M. Roller and J. A. Stouffer localities, and this might cause some concern over the correlation were it not for the fact that a sharp descent in the Middle Kittanning coal is present at the M. Roller exposure. The Lower Freeport sandstone is a steady member from the Less mine south as far as the road cut opposite the M. Roller section. It varies in position from a few feet above the Middle Kittanning coal to resting directly upon or even cutting out and replacing that coal. The base of this sandstone is a disconformable one. This relationship of the Lower Freeport sandstone accounts for the absence of the marine Washingtonville shale at several of the described localities. Fortunately the Washingtonville member is present not only in its type section at the J. A. Stouffer mine but also along the road opposite the M. Roller buildings and in the Less mine itself.

That brings us back to the original problem—the identity of the coal and clay in the old Reichstadt mine at the Kopp Klay plant. To the evidence already presented concerning this mine from the written reports of Orton, Stout, and Lamborn, a few additional facts can be added. Mr. Ira Wisler, who was a miner for a number of years in the Reichstadt mine, has recently informed me that at a close but variable distance above the top of the coal was the base of a heavy sandstone which is undoubtedly the Lower Freeport. He further reported a few inches of black "slate" on top of the coal, and concerning this "slate" Orton wrote as follows:[9]

"There are 2½ feet of bituminous coal, overlain with 4 to 6 inches of cannel."

The same is present in the Less mine where it is six inches thick. The underclay which had a thickness of ten or more feet was without any trace of a second layer or even streaks of coal but did contain at least locally some nodules of presumably clay ironstone or limestone larger than the size of one's first. The ware made from this clay forms little blisters from iron impurities at 2100° F., but ware made from Lower Kittanning clay from nearby North Lima is without similar blisters when burned at a temperature of 2700° F.

While I have no accurate drill records at or near this mine, the general report is that there is another coal about 40 feet below the coal worked in the Reichstadt mine, which, if true, would be the Lower Kittanning coal.

This great thickness of the clay in both the Reichstadt and Less mines is typical of the Lower Kittanning clay combined with the Lawrence clay, rather than of the Middle Kittanning clay in this vicinity. Orton reported, however, that two and a half miles further south in the old Walters mine the Middle Kittanning clay was seven feet thick.[10]

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[9]Orton, Ed.: *Op. cit.*, p. 33.

[10]Idem., p. 33.

The elevation of the coal in the Reichstadt mine has not been accurately determined, but Orton wrote that it was 15 feet above the Erie Railroad, which would make it a few feet higher than it is in the Less mine across the valley.

All the available evidence concerning the Reichstadt and Less mines convinces me that the Middle Kittanning coal and clay are present in both and that Orton was correct when he correlated the coal in the Reichstadt mine with the Middle Kittanning coal in the vicinity of Washingtonville.

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Bird Behavior

Volume I of this series ("A Population Study of the Song Sparrow," Trans. Linn. Soc. N. Y., Vol. 4, 1937) dealt with the vital statistics of a group of song sparrows in Columbus, Ohio; the present volume deals with the behavior of passerine birds, with the song sparrow as the chief example, and takes the bird from hatching to maturity and through its own parental activities. These two volumes are the result of a thorough and painstaking study over an 8-year period of a song sparrow population in Columbus, Ohio, together with numerous observations in Massachusetts and Oklahoma, and observations on some two dozen hand-reared birds in Austria and in this country. This is probably the most thorough study ever made of a single species of bird.

Following a brief outline of the general principles of animal psychology as they relate to birds (Ch. I), the author in succeeding chapters discusses the various activities of the bird throughout its life: the development and behavior of the young bird (II-VI), the general nature of the song sparrow society (VII), awakening and roosting (VIII), the nature, development, inheritance, and function of song (IX-XI), territory in the song sparrow and other birds (XII-XIII), mating and inter-individual relationships (XIV-XVI), the nest, eggs, and care and defense of the young (XVII-XX), enemy recognition (XXI), innate and learned behavior in the adult bird, and analogies with the behavior of other vertebrates (XXII). At the end of each chapter is a brief summary of the subject matter in the chapter. The appendices (I-V) contain detailed accounts of vocalization, dominance, and pair formation in song sparrows, and a list of species in which injury-feigning has been reported. At the end of the book is a 29-page bibliography and a complete index.

This volume presents a very thorough analysis of bird behavior. A tremendous amount of work, both in the field and with the literature, has gone into the preparation of this volume. Few people have the patience, or the command of the literature (particularly the European literature), to carry on a study of this sort. A vast amount of the author's detailed observations is included, but the material is well organized and clearly presented. A number of questions are raised which should stimulate further study.

This book is essentially a monograph on bird behavior, with particular reference to the song sparrow. We recommend it heartily not only to all ornithologists, but to anyone interested in animal behavior. It is a compendium of information on the subject.—*D. J. Borror.*

Studies in the Life History of the Song Sparrow. II. The Behavior of the Song Sparrow and other Passerines. By Margaret Morse Nice. Trans. Linn. Soc. New York, VI, September, 1943. Pp. viii+329, 1 plate, 6 figures, 26 tables; paper bound, 6 x 9 inches. Price, $2.75.

A Picture-Cyclopedia of Flowers

To recognize familiar flowers quickly this small book has its uses. Prepared in the manner of commercial catalogs and by the Horace MacFarland Company, it forms a valuable small work handy for quick reference. There are 350 colored illustrations. A chapter on pests prepared by T. L. Guyton will be read with interest by his Ohio State friends.—*A. E. Waller.*

Garden Flowers in Color, by Daniel J. Foley. Macmillan Company, New York, 1943. $1.98.

ANALYSES AND CORRELATION OF FOUR NEW HAMPSHIRE BOGS

ROBERT W. KRAUSS AND GEORGE N. KENT,[1]
Oberlin College, Oberlin, Ohio

The understanding of recent paleoecology by means of the pollen analyses of strata in post-glacial bogs has developed to the point where most ecologists, and even many laymen, are familiar with the usual methods involved. Although large numbers of bogs have been analyzed and discussed with regard to the immediate locality to which they belong, there is still considerable dispute concerning the paleoecology inferred from correlations of these analyses. It is only fair to admit that much of the confusion is due to many missing links in our chain of evidence. The fact of missing links, however, is characteristic of all history, whether natural or human. This paper therefore presents another link in the chain and attempts to point out not only the implications immediately involved in the analysis of four New England bogs, but the inferences drawn from a correlation of a number of other bogs along the Atlantic Coast.

The bogs analyzed by the writer are located in the southeastern part of New Hampshire within the drainage basin of the Merrimac River. The first, Perkins bog, is one-half mile southeast of Center Barnstead in the valley of the Big River. This bog covers several acres of kettle holes and is the most northerly of those considered. Ponemah Bog lies one mile southeast of Ponemah and three miles east-southeast of Milford and consists of about 100 acres in a depression of the Souhegan outwash plain. Spruce Bog is one to two miles north-northeast of Fremont Station and consists of about 200 acres. Welsh Bog, one mile east of Raymond near the Lamprey River, rests in a kettle hole of about seven acres. The bogs are grouped closely enough to indicate a close concurrence of the analyses. The entire area was covered by the Wisconsin Ice Sheet which extended south as far as New Jersey. The bogs do differ, however, in that those of Fremont and Raymond were under salt water during the brief marine submergence of the lower Merrimac Basin as shown by Antevs (1922). Therefore since the date of retreat of the ice (probably from ten to fifteen thousand years ago) and since the retreat of the sea from the area occupied by the two bogs above mentioned, the region has been open to the stages of succession governed by climate to the present time. Apparently the record in each bog is complete from the beginning of peat formation to the present, as the upper levels have remained intact.

The methods of boring and pollen extraction are, as a whole, familiar. The borings were taken at one-foot intervals with a Davis Borer. The deepest boring was taken at the end of actual peat on the bottom of the bogs. It would have been more desirable if some penetration into the sand and clay bottoms below the peat could have been made. Significant additions to the profiles were secured in this manner by Deevey (1939). The samples of peat (about ten c.c.) were placed in 50 c.c. vials of alcoholic potash and sent to the Oberlin Botanical Laboratory. From each vial, from .5 to 1 c.c. of material was removed—by tweezers or by pipette if well digested—and placed in a centrifuge tube to be boiled for a short time with 10 per cent KOH to complete the digestion of the peat.

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[1]Material was collected by the junior author, now with the armed forces. The analyses and all correlation were done by the senior author who also prepared the manuscript. He wishes to express his thanks to Dr. Paul B. Sears for liberal instruction and for the use of his splendid library. Dr. George T. Jones, of Oberlin, has read the manuscript and offered many helpful suggestions.

The digesting action of the alcoholic potash alone was not sufficient for best results in spite of the fact that it had been present for some time.

It may be remarked that many methods were applied to the peat in an effort to make a selection of the most satisfactory system. The new Erdtman Technique (1933) and that of Barghoorn and Bailey (1940) were applied with a number of supplementary modifications. The time required by these new techniques, however, did not seem warranted by results with this material. It is not to be assumed from this that the writer considers the above-mentioned methods generally useless. Undoubtedly under other circumstances they are of value.

After boiling and staining with one drop of safranin per tube, the mixture was centrifuged and the pollen removed from the layer at the top of the peat. Enough of the coarser material from the bottom was added to the pollen layer to allow both for the inclusion of heavier pollen and the stabilization of the film when

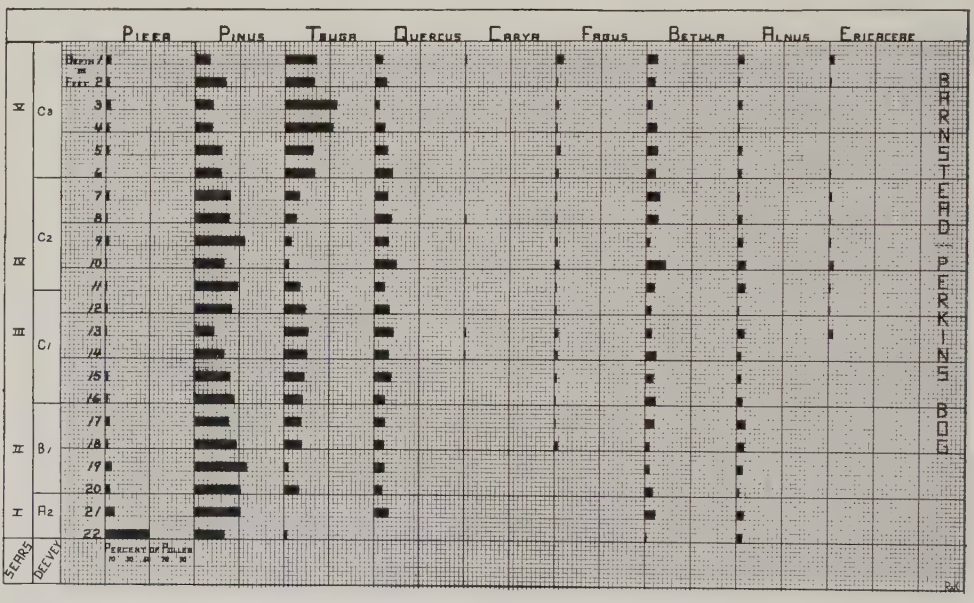

Fig. 1. Analysis of Perkins (Barnstead) Bog.

placed on the slides to dry. Drying completed, the slides were mounted with glycerine jelly. The resulting mounts were excellent in both the number and condition of the pollen grains present. These slides were then counted for 100 grains per level. In certain cases duplicate slides were made in order to check the counts.

As an aid to the discussion of results, the writer will use one bog as a key to which the others will afterward be referred. The bog at Barnstead being the deepest, it is the most logical starting point for this correlation (fig. 1). Beginning the examination with the bottom layer, Spruce is obvious as the dominant. This dominance is characteristic of a cold climate. It is true, of course, that Spruce can be expected in bogs in fairly warm regions, but further investigation of Spruce decline shows that Spruce disappeared from the region except in the bog itself. Deevey (1939) considers a like Spruce maximum in Connecticut the result of the deterioration of climate which had warmed but cooled at this point, due, perhaps, to some readvance of the ice sheet. At all odds, it seems that this period of Spruce dominance can best be placed near the second phase of Deevey's earliest period,

lettered A_2. It is the same period which Sears (1942) finds in his discussion of profiles in the Central States and is lettered I. This of course is the cold period which we know must have been represented by the same species of trees as those found in the Northern Coniferous Association today. How long after the retreat of ice it was before arborescent forms began to appear is not yet certain and the writer will therefore make no attempt to date this period. For those interested, however, the dates as set by De Geer (1910) for the early cold period are from 10,000 to about 8,000 years ago. It is apparently near the end of this cold period that the Barnstead Bog began its formation. Whether this Spruce maximum is the first forest community, or if, as indicated by the work of Deevey, it is the second stage of the first community, I am at this point unable to say.

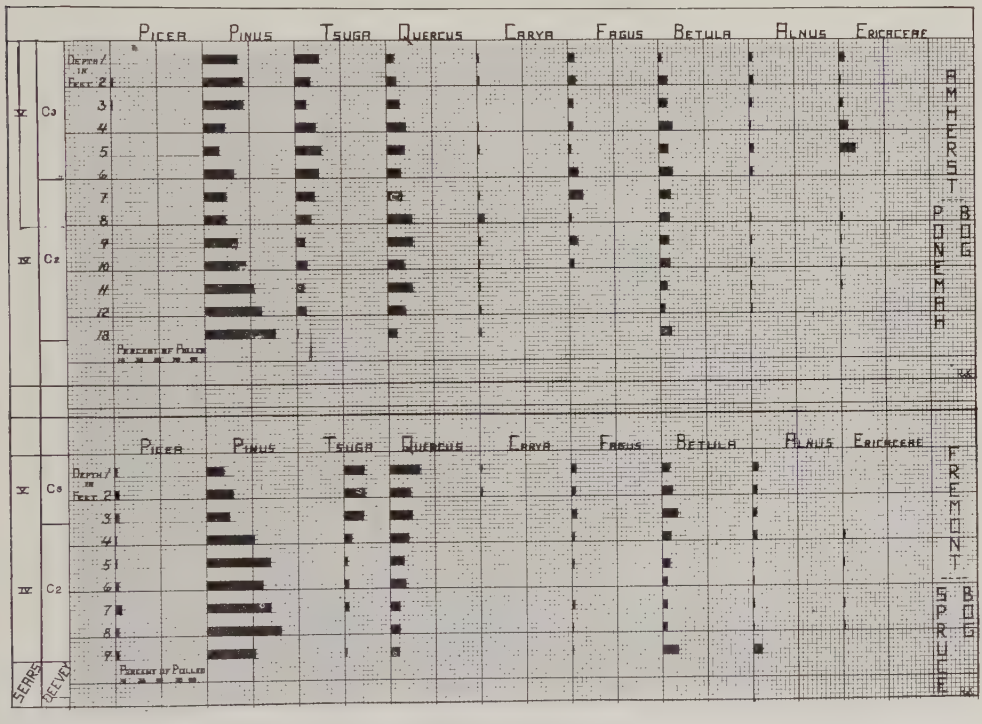

Fig. 2. Analyses of Ponemah (Amherst) Bog (above) and Spruce (Fremont) Bog (below).

Moving on up the profile, there is a quick end of the Spruce dominance. It is replaced mainly by Pine which correlates beautifully with the period marked II by Sears (1942) and B_1 by Deevey (1939). This period shows erratic increase of Hemlock and an increase in Oak. Though the species of Pine and Oak cannot be differentiated, there is considerable indication that this period may have been both cold and dry.

In the next period, letter III or C_1, the Hemlock attains significance and its first maximum appears. Immediately thereafter a deep drop in Hemlock occurs, succeeded again by a maximum near the top. The period of Hemlock minimum (apparently a dry or dry warm one) is paralleled by an Oak maximum (dry) and a Pine maximum (probably Jack Pine) as well. It is extremely unfortunate that we are unable to differentiate between species of Pine. We can only surmize that in view of the spectra the Pine is a xeric species. To show that this species is a xeric one would clinch the supposition that the cool moist period (No. III) was

followed by a dry warm one. With this generalization, the spectra seem to be consistent. Beech, with the exception of an increase at level 10, also shows a decline during the warm dry period.

The increase in Beech at the top layer accompanied by a decline in Pine and Hemlock and an increase in Oak and Birch indicates a balanced Beech-Hemlock forest with large numbers of Pine, Oak, and Birch in preclimax stands. This agrees well with the present forest associations.

With periods of the Barnstead Bog pointed out, the other profiles may be examined for correlations. Taking first the bog at Amherst, it is found to be of later inception than the one at Barnstead. The lower levels showing the Spruce dominance are not found here. On the other hand, the Hemlock minimum is found at the bottom, identifying the beginning of peat formation to be in the period marked IV in the Barnstead profile. The same correlation with Pine and Oak may be made here. Beech alone seems a bit out of line which may be in part due to the average low incidence of Beech pollen—a point of difficulty in all genera of lesser representation.

The remaining two bogs are much shallower than the rest. It is to be remembered that these were under salt water during the submergence of the lower

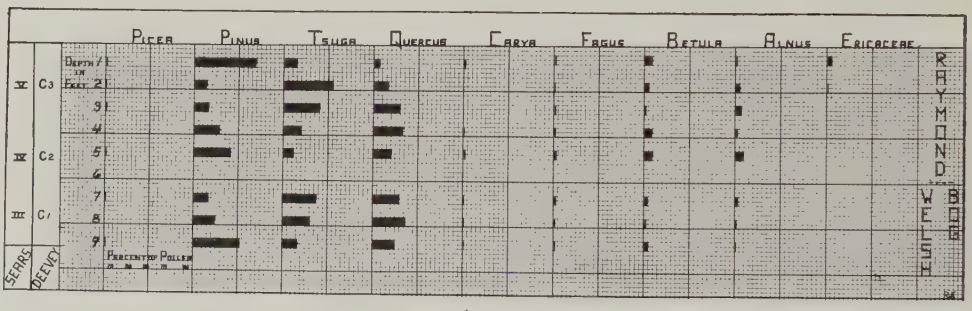

Fig. 3. Analysis of Welsh (Raymond) Bog.

Merrimac Basin. Recovery from this submergence could not have been accomplished soon. Therefore the latter two, Fremont and Raymond, correspond to the upper portions of the former two.

The Hemlock minimum in the Fremont bog is again as is to be expected; and the Beech increase is steadier than elsewhere. The Oak increase at the top, however, is worthy of remark. Possibly the Oak found here is of the mesic Red Oak group, common successionally in the typical Beech-Hemlock forest. Again may we stress the point that a differentiation of the species of Oak is at present impossible and that it would be necessary to clinch our arguments. We have much data for fairly accurate substantiation of our own hypothesis if only these species differentiations were clear. This circumstance limits us to broader generalizations, for no matter how many analyses are made, precision will be impossible unless we can know the species of Oak and Pine in particular. The protests of Potzger (1942) and others against making any generalizations as to climate seem to us, however, scarcely warranted in view of the evident broad correlations between our results and those of Potzger (1943) and Deevey (1939).

Going on to the Raymond Bog two difficulties are met—although as a whole the bog agrees with the other three. The first problem is the recent increase of Pine not shown in the others. This may be due to the interference of man by lumbering or fire. At all odds, it is naturally unexpected and may be open to speculation. The other is that in this shallow profile we have two Hemlock

minima. This would indicate a slow filling over a longer period than that of the Amherst Bog. This, though possible, is difficult to explain. The very small size of the bog may have much to do with a slow rate of filling or the local vegetation

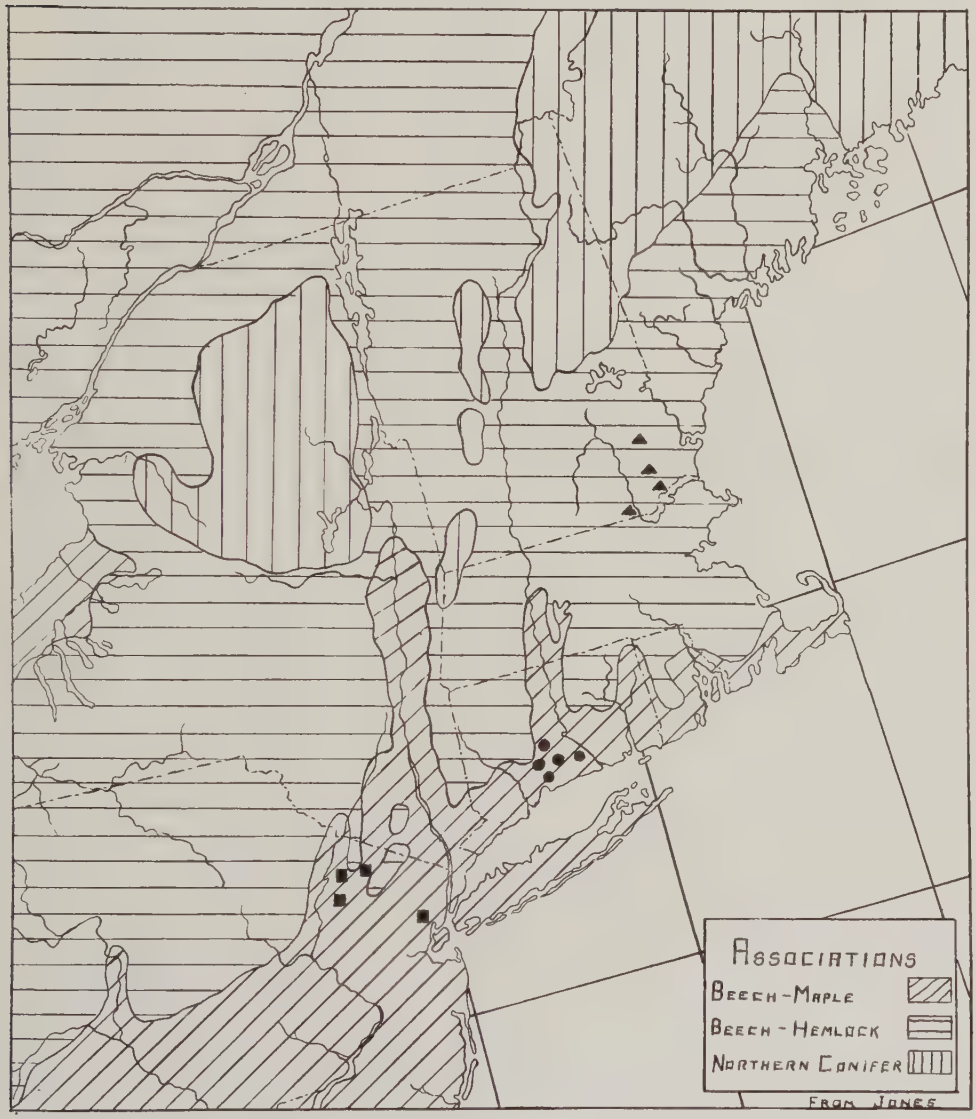

Fig. 4. Location of Coastal Bogs referred to in text.

may have disturbed the profile. The erratic formation of kettle holes and resulting deposition of peat is mentioned by Deevey (1939) and is a problem in any correlation.

What inferences may now be drawn from these results? First, it is obvious that these profiles indicate clearly the presence of a cool dry period after the close of the Spruce maximum. After this dry period, the Hemlock swings up to a maximum and a mesic forest community is indicated by the presence of the typical trees of the present Beech-Hemlock association. A dry and warm period follows, as shown by the marked decrease in Hemlock in agreement in all bogs. Oak and Pine species which we assume to be xerophytic occupy a dominant place in this period after which the Hemlock increases as Pine and Oak decrease and Beech increases to make up the present Beech-Hemlock-Pine forest. In the top layers there is evidence of the work of man as well.

In searching for meteorological corroboration for these shifts of climate, the writer was for a time disturbed by the fact that in order to have the xerotherm pointed out by Sears, Deevey, *et al.* (at Hemlock minimum), the cyclonic-anticyclonic fronts which now occur in the middle New England region would, of necessity, be found further north. This being true, there seemed every reason to suspect that the recession of the cold dry polar air, which had kept out the warm moist air from the Atlantic, would allow this warm moist layer to sweep over the area producing not a warm dry period but a warm moist one. This would have brought about a displacement of the coniferous forest by a Beech-Maple forest, apparent in a bog profile by a great increase in Beech. Such an effect is not shown in any of our profiles nor in those of other workers in the region.

With the possibility of this oceanic influence ruled out, it is clear that a great air movement from the West must have carried dry hot winds far enough east to alter the expected climate of the Northeastern seaboard. Meteorologically this is sound, for any movement of the fronts northward would carry the air from the Mississippi Valley in a swing east which would not be halted by either the low New England Mountain Ranges or the easterly oceanic winds. Therefore a warming at this time would allow the New England States to be influenced by mid-continent climate more than at present. The fact that these easterly bogs were affected by a dry warm period shows definitely that this period, long suspected in the mid-continent, must have been truly a far-reaching one. It is substantiated by the presence of the prairies much farther to the east than at present and by the analyses of Auer (1930), Deevey (1939), and Potzger and Otto (1943). (The latter, however, ignore the Hemlock minimum in their own paper.) The fact of apparent movement of the forests north and then again south should be of great interest to those tracing movements of the polar ice.

There is one other point raised by this analysis, when correlated with the others in the region. In New Jersey, Connecticut, New Hampshire, New Brunswick, and Nova Scotia there is a uniform decline in the abundance of Hemlock at about the same relative levels. In this period of decline there is a variation in the species of trees which take the dominance from Hemlock. In New Jersey, in the dry period, Hemlock is replaced by Oak to a great extent. In Connecticut, the Oak is as active in replacing Hemlock as in New Jersey. We do find a tendency for Pine to press into the gap. We may safely say, however, that Oak is the main representative of the dry period in these two states. In New Hampshire the Pine is the important dominant at the Hemlock minimum. Still farther north in Nova Scotia and New Brunswick (see Auer, 1930) Oak is barely present and certainly Pine is the unequivocal dominant in the dry period.

What then does this dominance of Pine in the north instead of Oak, as in the south, suggest? A clue may be noted in that there is a tension zone of climate in the New England states. Here the cyclonic fronts caused by the conflict of cold polar air with the warm southern air rule the weather. As could be expected, it is through this area that the general line separating the Beech-Maple association from the Beech-Hemlock is found. (Clements and Weaver, 1938; Jones, 1940.)

In figure 4, the bogs in New Jersey and Connecticut are seen to be in what today is Beech-Maple. Those in New Hampshire, Nova Scotia, and New Brunswick, on the other hand, are in the Beech-Hemlock Association. It appears, then, that the warm dry period produced not a northward movement of the Beech-Maple association nor any real shift of boundary at all but rather that the xeric types found in this period represent the xeric series *in their own respective associations.*

It is notable that there is such a pronounced difference in the xerotherm forests of New Hampshire and that of the same period in Connecticut only one hundred miles to the south. It is as though the climax association of today were reduced to the xeroseres peculiar to each. Is not this just what we would expect when we realize that a climax condition had been reached and well established before the beginning of the xerotherm? Nevertheless it is surprising that the line today should correspond so closely to what it was perhaps three or four thousand years ago. It indicates a stability of forest associations and their seres not previously pointed out and certainly calls for further ecological investigations.

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Cytology

This new book by Professor Sharp is intended as an elementary text to be used in courses following beginning botany and zoology. The plan is similar to that of his well-known "Introduction to Cytology," but with the material receiving a simpler treatment in an attempt to meet the level of understanding of students with only an elementary background. The first chapter traces cytological developments and outlines the position of cytology in biological science. The following chapter is a discussion of the organism as a whole and the cell. The next four chapters present the structural components of protoplasts, the physical characteristics of protoplasm, division of the protoplast and the cell wall structures. The structure of chromosomes is discussed and nicely illustrated in Chapter 7. This discussion includes the giant chromosomes of *Drosophila*, *Sciara* and *Chironomus*. The subject of Chapter 8 is Meiosis. The chapter is carefully written and illustrated, including material from both plants and animals. The succeeding three chapters deal with the cytology and reproduction in plants and animals. These are followed by chapters on cytology and Mendelian heredity, chromosomal aberrations, chromosome numbers and their alteration and cytological aspect of hybridity. This includes recent work on the induction of tetraploids by use of colchicine, resulting in new fertile types from sterile but desirable hybrids. A brief summation of our knowledge of the role of cytoplasm in development and heredity appears in Chapter 17. The last chapter adds a new phase and application of cytology to the important biological problem of taxonomy. No specific references are given in any of the chapters. However, at the end, ten pages of "Suggested Reading" are included. This new work of Professor Sharp will likely meet the need of many as a text for undergraduates.—*G. W. B.*

Fundamentals of Cytology, by Lester W. Sharp; 267 pages, 6 x 9, 176 illustrations. McGraw-Hill Book Company, New York. $3.00.

THE GENETICS OF CERTAIN COMMON VARIATIONS IN COLEUS[1]

DAVID C. RIFE,
The Ohio State University,[2]
Columbus, Ohio

Coleus are characterized by great variations in leaf color, and to a lesser degree by variations in leaf form and flower type. Genetic breeding experiments now being conducted at the Ohio State University have to date revealed at least eight sets of alleles responsible for many common variations.

Boye and Rife (1937) reported the difference between solid purple leaf color and green leaves with a brown pattern on the upper epidermis (see Fig. 1) to be due to a single pair of alleles, purple being dominant to pattern. Likewise, in the Golden Bedder strain, solid green appeared to be dominant to pattern. Another set of alleles was shown to determine whether the plant has an intense or dilute green pigmentation, the intense green being dominant to the dilute green. Later work by Boye (1941) showed that the genes responsible for solid purple, solid green and pattern belong to a single allelic series. The gene responsible for solid purple, (P) and the one responsible for solid green (p^G) are each dominant to the one resulting in pattern (p). The genes P and p^G show no dominance to each other, plants of genotype Pp^G being of a bronze gray color. The genes responsible for intense and dilute green (I, i) do not appear to be linked with the P series (see Table 6b).

Crinkly leaves have been shown to be due to a single dominant factor (C) and smooth leaves to its recessive allele (Rife, 1940). The P and C series are not linked. Deep lobed leaves were shown to be due to a simple dominant factor, and in the strain investigated by Rife (1940), were always associated with male sterile flowers.

PATTERN, MOTTLING AND SOLID COLOR

Coleus plants frequently exhibit various degrees of speckling or mottling of anthocyanin on the upper leaf surface; as contrasted with either a characteristic pattern or complete absence of anthosyanin (Fig. 1). There is great variation in the type of mottling, which would seem to indicate that multiple factors are concerned in its expression. Table 1 shows the results of selfing several mottled plants. In each instance patterned, mottled and solid colored progeny were produced. Patterned plants from such progenies always breed true, and solid colored plants usually do so. This would seem to indicate that mottling is due to the heterozygous state of the factors determining pattern versus solid color. An examination of Table 1 shows that the ratios deviate significantly from a 1 : 2 : 1, there being too few mottled and too many solid colored plants. If we test progenies for 3 : 1 ratios (three solid and mottled, one patterned), however, there is no significant deviation from the expected. Slight mottling frequently will not appear until the plants have become fairly large. Space limitations usually render it impossible to maintain complete progenies until they have reached such size, and it seems likely that when the counts were made, many potentially mottled plants were classed as solid colored. We shall henceforth use the symbols TT to designate the genotype of solid color, tt the genotype of patterned plants, and Tt that of mottled plants. The degree of mottling is apparently determined by multiple modifiers.

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[1]Genetic Studies of Coleus No. IV.
[2]Department of Zoology and Entomology, Genetics Laboratory.

When plants of genotypes tt and Tt are crossed with plants of genotype $p^G p^G$ all of the progeny are solid green. When plants of genotype TT are crossed with plants of genotype PP, the progeny are purple, rather than bronze gray. These observations indicate that the p factor of the purple series does not result in the

FIG. 1. Color variations in coleus leaves. Upper row, solid green on left, pattern on right. Middle row, speckling and mottling. Lower row, distinct pattern and chlorophyll deficient on left, faint pattern and chlorophyll deficient on right.

formation of a pattern, but rather is responsible for a solid green, phenotypically the same as that produced by p^G. The two types of solid green differ in breeding behavior in that p^G is epistatic to t, whereas T is epistatic to p. Apparently the plants used by Boye (1941) in the analysis of the P series were homozygous for tt, thus making it possible to differentiate between the two types of green on the basis of the presence or absence of patterns.

TABLE 1

ANALYSIS OF DATA OBTAINED BY SELFING MOTTLED AND SPECKLED PLANTS

A.

Seed Sample	*Pattern*	*Mottled*	*Solid*	X^2	*df*	*Probability*
1	25	33	42	17.340	2	very small
2	17	20	17	3.628	2	0.3 –0.05
3	6	16	12	3.353	2	0.3 –0.05
4	20	36	23	0.638	2	0.95–0.7
5	5	8	9	3.231	2	0.3 –0.05
	73	113	103	28.190	10	very small

Deviation
df=2
X^2=20.274
p=very small

Heterogeneity
df=8
X^2=7.984
p=0.5–0.3

B.

Seed Sample	*Pattern*	*Mottled and Solid*	X^2	*df*	*Probability*
1	25	75	0.0001	1	0.99
2	17	37	1.390	1	0.3 –0.05
3	6	28	0.789	1	0.5– 0.3
4	20	59	0.001	1	0.99
5	5	17	0.001	1	0.99
	73	216	2.181	5	0.95–0.7

Deviation
df=1
X^2=0.009
p=0.99

Heterogeneity
df=4
X^2=2.172
p=0.97–0.70

LEAF LOBES AND MALE STERILITY

In addition to the strain of plants in which deep lobes are associated with male sterility reported by Rife (1940), deep lobes have subsequently been discovered in two other strains. In one of these the male flowers are completely fertile, and the degree of lobing is indistinguishable from that in the strain characterized by male sterility. In the other strain there is variability in the degree of lobing in the heterzygous plants, which usually show lobes not so deep as do plants homozygous for deep lobing. Homozygous deep lobed plants are almost completely male sterile, although a few seeds have been obtained from them. The heterozygous plants show a fair degree of fertility, much less than do the shallow lobed plants. This type of deep lobing appears to be semilethal in the homozygous state, as such plants develop only rarely. Selfed heterozygous plants give ratios among their offspring approaching two deep to one shallow, more closely than three deep to one shallow (see Table 2c). Thus we have the following four types of plants in regard to deep lobing and male fertility; deep lobed and male sterile, deep lobed and partially male sterile which are semilethal in the homozygous state, deep lobed and male fertile; and shallow lobed and male fertile. No shallow lobed male sterile plants have been obtained.

There are at least three possible explanations for this breeding behavior. There may have been three independent mutations at different loci, one of which resulted in deep lobes with no effect on sterility, another which resulted in deep lobes and partial male sterility, and a third which resulted in deep lobes and complete male sterility. If true, plants heterozygous for any two of the three types of deep lobing should give three types of offspring when crossed with shallow lobed, male fertile plants. Two of such crosses have been made, as shown in Tables 2a and 2b.

TABLE 2

Analysis of Data on Leaf Lobing and Male Sterility

A.

Deep ♂ sterile x heterozygous deep ♂ fertile.

12 deep ♂ sterile;
7 deep ♂ fertile;
8 shallow ♂ fertile.

Five of the deep ♂ sterile were crossed with shallow ♂ fertile.

One gave 30 offspring, all deep.
" " 32 " 17 deep, 15 shallow.
" " 17 " 8 deep, 9 shallow.
" " 5 " all deep.
" " 8 " 6 shallow, 2 deep.

B.

Deep ♂ sterile x heterozygous deep partially ♂ sterile.

2 deep completely sterile.
3 deep partially ♂ sterile.
2 deep ♂ sterile.
2 shallow ♂ fertile.

Two of the deep partially ♂ sterile, and one of the deep completely ♂ sterile were crossed with shallow ♂ fertile plants, and in each case produced offspring in the ratio of approximately 1 deep to 1 shallow.

C.

Segregations Obtained by Selfing Heterozygous Deep Lobed Partially ♂ Sterile Plants

Sample	*Deep*	*Shallow*
1	10	5
2	11	3
3	8	3
4	25	12
5	28	15
6	10	2
Total	92	40

	P
1 df X^2 value of deviation from 3 : 1 ratio = 1.979	0.3–0.05
X^2 " " " " 2 : 1 " = 0.544	0.5–0.3

In no instance were more than two types of offspring produced from such, definitely indicating that independent mutations cannot account for the variations.

It is possible that a single pair of alleles may be responsible for deep and shallow lobes, and another set of alleles responsible for variations in male sterility. If so, these two sets of alleles are so closely linked that they rarely, if ever, cross over. The other alternative is that the variations in both leaf lobes and male sterility are due to a single set of four multiple alleles, which may be represented as follows: L-deep male sterile, l^P-deep, partially male sterile, l^F-deep, male fertile and ll shallow, male fertile.

Which of these latter two hypotheses is correct could be established only by the appearance of a shallow lobed male sterile plant or a new mutation affecting both lobes and male sterility. It is apparent, however, that the genes affecting lobing and male sterility are at the same or almost the same chromosome locus.

TABLE 3

DATA ON PURPLE VS. GREEN LOWER EPIDERMIS

A.			B. Backcross Segregations		
Sample	*Purple*	*Green*	*Sample*	*Purple*	*Green*
1	21	8	1	16	17
2	135	41	2	16	14
3	33	11	3	38	43
4	14	7			
Total	203	67	Total	69	74

TABLE 4

F_2 SEGREGATIONS GREEN VS. WHITE OR PINK AREAS

Sample	*Green*	*White or Pink Areas*
1	132	44
2	22	5
3	71	27
4	67	15
	292	91

TABLE 5

HETEROZYGOUS FAINT PATTERN SELFED

Faint	*Dark*	X^2	*df*	*P*
35	8	0.843	1	0.5–0.3

LOWER EPIDERMIS, CHLOROPHYLL DEFICIENCY AND FAINT PATTERNS

Lower leaf surfaces may be either purple or green. Purple lower leaf surfaces are usually associated with reddish stems and leaf veins. As shown in Table 3, backcrosses of purple x green lower epidermis give 1 : 1 ratios, and F_2 segregations of 3 purple to 1 green. Apparently, then, purple lower epidermis (B) is dominant to green (b).

White or pink spots, due to the absence of chlorophyll, are frequently found in the center of coleus leaves. The extent of these spots is variable, ranging from a narrow stripe along the midribs of the leaves, to areas covering almost the entire leaf surface. Crosses between solid green and chlorophyll deficient strains give solid green progeny, and in the F_2 ratios of approximately 3 solid green to 1 chlorophyll deficient, indicating that solid green (A) is dominant to this type of chlorophyll deficiency.

Faint patterns, as contrasted with distinct patterns shown in Figure 1, are sometimes found. Whether the pattern is distinct or faint apparently is independent of the type of green, and is determined by the type and distribution of anthocyanin. A faint patterned plant when selfed, produced offspring in the ratio of approximately 3 faint to 1 distinct, (Table 5), suggesting dominance of the faint pattern (O) to the distinct (o).

LINKAGE

At least eight sets of alleles are indicated as being responsible for the variations discussed in this paper. Of the 28 possible linkage relationships 11 have been tested, as shown in Table 6. In none of these tests do the ratios obtained deviate significantly from what one should expect on the basis of random assortment, thus giving no indication of linkage.

TABLE 6

TESTS FOR LINKAGE

A

Backcross, P and L allelic series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
29	34	23	20	4.537	3	0.3–0.05

B

Backcross, P and I allelic series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
22	23	30	21	4.075	3	0.3–0.05

C

Backcross, I and L allelic series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
26	32	17	31	5.959	3	0.3–0.05

D

Backcross, B and L series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
22	23	19	17	1.826	3	0.7–0.5

E

Backcross, A and L series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
20	14	19	28	4.924	3	0.3–0.05

F

Backcross, A and B series.

Non-crossovers		*Crossovers*		X^2	*df*	*P*
25	18	15	23	2.986	3	0.5–0.3

G

F_2 segregation, A and I series—Test for deviation from 9 : 3 : 3 : 1 ratio.

*A_I_*	*A_ii*	*aaI_*	*aaii*	X^2	*df*	*P*
107	25	34	10	2.704	3	0.5–0.3

H

F_2 segregation, B and I series—Test for deviation from 9 : 3 : 3 : 1 ratio.

*B_I_*	*B_ii*	*bbIi*	*bbii*	X^2	*df*	*P*
110	25	31	10	2.379	3	0.5–0.3

I

Cross of Iill x IiLl—Test for deviation from 3 : 1 : 3 : 1 ratio.

				X^2	*df*	*P*
27	12	30	12	1.070	3	0.95–0.7

J

Selfed plant of genotype OoLl—Test for deviation from 6 : 3 : 2 : 1 ratio.

				X^2	*df*	*P*
24	11	4	4	1.982	3	0.7–0.5

SUMMARY

1. Leaf patterns in coleus are due to the homozygous state (tt) of a pair of alleles. The heterozygous state (Tt) produces mottling or speckling, and the other homozygous state (TT) results in solid green. Solid green due to p^G is epistatic to both Tt and tt, while Tt and tt are epistatic to p.

2. Four genes, either closely linked or belonging to the same allelic series, are responsible for variations in leaf lobes and male sterility.

3. Purple lower epidermis of leaves is dominant to green, solid green leaf color is dominant to white or pink spots, and faint leaf patterns appear to be dominant to distinct leaf patterns.

4. Tests gave no evidence for linkage between P and I, P and C, P and L, B and L, B and A, B and I, A and I, A and L, I and L, and O and L.

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The Culture of Plant Tissues

Literature pertinent to plant tissue culture dates back for about a century, with the major progress having been made since 1930. The interest in this field has developed to the point that a methods book on the subject is needed. This has appeared in the form of "A Handbook of Plant Tissue Culture." A skilled technician in this field and one who has played a leading part in the development of this branch of plant science, Dr. Philip R. White, has prepared a guide which meets the needs felt by many students of experimental morphology and physiology. The philosophical and historical background is covered in the first two chapters. The third chapter deals with materials which may be successfully cultured. In a succeeding chapter detailed description is given of a suitable laboratory for such work. Equipment is discussed with suggestions for successful manipulation. Other chapters deal with the preparation of cultures, point out merits and demerits of various techniques. The preparation of appropriate synthetic nutrient media is clearly presented. Suggestions for growth measurements and their interpretation are presented in Chapter VIII. The last two chapters, IX and X, deal with the significance of plant tissue culture in relation to general physiology and to morphogenesis in plants. These two chapters are likely to encourage new students in the field.

An excellent bibliography containing 457 citations will be valued by all interested persons. A detailed index of subject matter is included. This book will serve as an efficient guide for all who are interested in the subject.—*G. W. B.*

A Handbook of Plant Tissue Culture, by Philip R. White. Pp. xiv+277; 71 illustrations. The Jaques Cattell Press, Lancaster, Pa. 1943. $3.75.

Biochemistry and Morphogenesis

New scientific books are continually being produced. Only rarely, however, does one of the calibre of Needham's Biochemistry and Morphogenesis make its appearance. It is a veritable encyclopedia of present day knowledge concerning biochemistry in relation to embryology. Some idea of the scope of the book may be gained from the observation that the bibliography covers 70 pages, and that data from over 600 scientific periodicals are cited. The book is composed of three parts. Part I, The Morphogenetic Substratum, is concerned with the chemical raw material of development, and the information gleaned from embryology relative to nutritional problems. Part II, The Morphogenetic Stimuli, discusses the roles of evocators and primary and second grade organizers in various animal groups. Sixty-five pages are devoted to genes and organizer phenomena. Part III, The Morphogenetic Mechanisms, gives comprehensive discussions of dissociability, heteraupesis, respiration, metabolism and polarity. Indices of plants, animals and genes mentioned are included. This book should prove to be an indispensable reference for up-to-date biologists.—*D. C. Rife.*

Biochemistry and Morphogenesis, by Joseph Needham. 800 pages, 328 illustrations, including 35 full page plates (4 in color). The Macmillan Company, Cambridge University Press Department, New York. 1942. $12.50.

A NEW ASYMMETRIC COSMARIUM[1]

CLARENCE E. TAFT,
Department of Botany,
The Ohio State University

Species of Cosmarium which are characterized by the asymmetric condition of the semicells are extremely rare. Rich, in a report on the "Algae from a Pan in Southern Rhodesia," published in the Trans. of the Royal Society of South Africa, Vol. 23, 1935, described *Cos. asymmetricum* and stated that it was the only species to her knowledge in which one-half of the semicell is not a reflection of the other. It is readily distinguished from *Cos. zygomorphicum* by the smooth cell wall and small size.

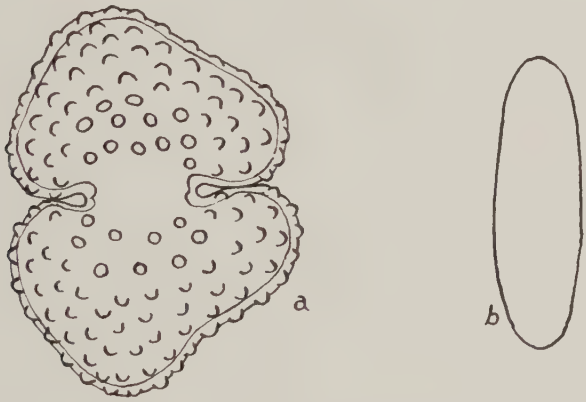

FIG. 1. *Cosmarium zygomorphicum* sp. nov.
a. Face view. b. Outline of cell in end view.

Cosmarium zygomorphicum sp. nov.

Cells of medium size, slightly longer than broad, deeply constricted, sinus closed. Semicells strongly asymmetrical, subpyramidate. End view narrowly elliptic. Cell wall coarsely granulate. One chloroplast with one pyrenoid in each semicell. L. 46–48μ; w. 35–37μ; isth. 10–13μ.

Semicellulis in aspectu frontali asymmetricis. Long. 46–48μ; lat. 35–37μ; isthm. 10–13μ.

Oklahoma, Puerto Rico, Indiana, Arkansas.

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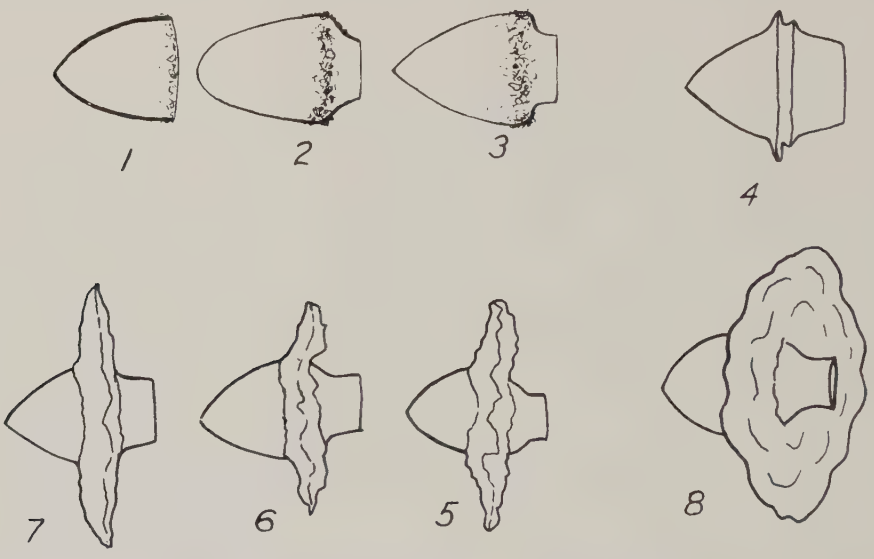
[1]Papers from the Department of Botany, The Ohio State University, No. 467.

A UNIQUE VARIANT OF CHRYSOCOCCUS ASPER LACKEY

JAMES B. LACKEY,
Senior Biologist, U. S. Public Health Service,
Cincinnati, Ohio

In January, 1941, several one liter samples of water were collected by the courtesy of Mr. Claudeous J. D. Brown, of the Michigan Institute for Fisheries Research, at various depths under the ice in Third Sister Lake. In April a second set of samples was collected. Both sets of samples were preserved with formalin and stored in the dark until sedimentation of all organisms and debris was complete. The contained microorganisms were then identified and counted. The first set contained 32 identifiable species of Algae and Protozoa; the second set 34; and the total in both sets was 47. Chrysophyceae accounted for 8 species in the first set, 3 in the second.



FIGS. 1–8. Variations in *Chrysococcus asper*. (1) Rough shoulder and neck, pointed shell; (2) Rough shoulder and neck, rounded shell; (3) No neck or shoulder, slightly roughened, pointed shell; (4) Form occasionally seen in rivers, with roughened area forming two small ridges; (5–8) Third Sister Lake variant showing wide flaring collar of the shoulder region.

Most of these were species of *Chrysococcus* which occurred from the surface to a depth of 50 feet. Among these was a type with a wide flaring collar encircling the shell a short distance behind its anterior opening. At first it was thought to represent a new species but careful observation of a large number showed it to be a variety of *C. asper*.

The genus *Chrysococcus* was founded by Klebs (1) with the type species *C. rufescens*. Pascher (2) added the species *punctiformis*, *Klebsianus*, *dokidophorus* and *ornatus*. Nauman (3) added the species *porifer* and *cordiformis* in 1921, and in 1938 and '39 the writer (4, 5) added seven species. These 14 species appear to comprise the genus as far as known. In all situations examined *rufescens*, *ovalis*, *cylindrica*, *asper* and *major* have been the most abundant. The writer

has never seen *Klebsianus, dokidophorus, ornatus, porifer* and *cordiformis*. The species are rather clearly separated, although *rufescens* and *porifer* are close to each other, while *major* differs from *rufescens* principally in size and the lack of a posterior internal tubercle on the shell.

Usually the species do not exhibit a wide range of variation. *C. cylindrica* in the Licking River of Kentucky has shown rather divergent shell types, but all are clearly referable to the one species. *C. asper* has been perhaps the most variable. Its shell (Figures 1, 2, 3) may be pointed or rounded posteriorly, and there may be a constricted neck-like region, or the anterior end may be abruptly truncate. There is a tendency for one of these types to markedly predominate at any station where the species occurs in abundance.

Occasionally a form as shown in Figure 4 has been found. These have had the scabrous shell, but the roughening has extended to the formation of one or two small ridges encircling the shell in the shoulder region, ragged and uneven. Among the specimens from Third Sister Lake this region in many instances has become wide and flaring, forming a pronounced collar (Figures 5–8 incl.) so that single individuals might easily be mistaken for new species. There is a gradual transition, however, and it is apparent from studying a large number of individuals that all graduations exist between the typical *C. asper* types and the forms having the extreme collar. None-the-less no specimens were found in the April catches which were typical *C. asper* as in Figures 1 to 4; *C. rufescens* was abundant and *C. spiralis* occurred sparingly, but all others had wide collars as in Figures 5 to 8. If the intermediate forms in the January samples had been missed, there would have been a strong tendency to call the April forms of *C. asper* a new species.

These variants are an excellent example of variation in a given direction. *Chrysococcus* is apparently much more common to streams than to lakes, and this unusual type has not been encountered in streams. Third Sister Lake is deep, and the organism is photosynthetic; but to imagine the collar a flotation mechanism is futile, in view of its apparent added weight. We are thus left with another example of the query as to the cause of variations and with a renewed caution against species creation without examining large numbers of the questionable new forms.

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The Development of Scientific Thought

This volume is the third edition of a successful treatment of the broad outlines of the development of scientific thought. The author holds that the study of such a history has much to teach both about the inner meaning of science itself and about its bearing on philosophy and religion. In this edition, not only has a new chapter been added covering the years 1930–1940, but extensive changes have been made in the original text. The older part includes chapters on the science of the ancient world, the middle ages, the renaissance, the Newtonian epoch, and the nineteenth century. The approach is scholarly, but eminently readable. A strong philosophical theme pervades the historical account. The scientist in any field can not fail to have a broader and deeper understanding of his chosen life-work after reading the book.

L. H. Snyder.

A History of Science, by Sir William Cecil Dampier. xxiii+574 pp. Cambridge, at the University Press; New York, the Macmillan Co. 1942. $2.95.

A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART—AVES V—SPHENISCIFORMES

Part I[1]

FRED H. GLENNY,[2]
1148 Linden Avenue, Akron, Ohio

During 1941 and 1942 the writer had the opportunity of carrying out studies on the arrangement-patterns of the main arteries in the neck and thorax of five species of Penguins. This study was greatly facilitated by materials made available to him by the Division of Birds, United States National Museum, and the Department of Ornithology, Royal Ontario Museum of Zoology.

The materials for this study included single specimens of the Rock-hopper Penguin *Eudyptes crestatus* (Miller), the "Johnny" Penguin *Pygoscelis papua* (Forster), Humboldt's Jackass Penguin *Spheniscus humboldti* (Meyen), the Galapagos Penguin *Spheniscus mendiculus* (Sundevall), and one immature and two adult specimens of the Black-footed Penguin *Spheniscus demersus* (Linné).

Routine dissections and diagrams of the arterial arrangement in the neck and thorax were made. The information thus obtained is set forth in the following observations.

OBSERVATIONS

The basic arrangement-pattern of the Spheniscidae is exemplified by *Eudyptes crestatus* (Miller), and *Spheniscus demersus* (Linné), (Figure 1).

The aortic root (1) arises in the left ventricle of the heart, passes anteriorly and to the right before it divides to form the left and right innominate arteries (2) which in turn pass anteriorly and laterally to give rise to the subclavian (9) and common carotid (8) arteries. Shortly after the bifurcation of the aortic root, the right innominate artery sends off the right systemic (4th aortic) arch (3) which passes dorsally and posteriorly to join the right radix aortae (4). The radix aortae then passes diagonally posteriorly toward the central axis of the body where it continues as the dorsal aorta (23). At the point of junction between the radix and the dorsal aorta, the ligamentous vestige of the left radix aortae (ligamentum aortae) (5) may be found passing anteriorly and diagonally toward the left pulmonary artery.

In some species of birds (Beddard; Glenny, 1939, 1940, 1942a, 1943) the left radix aortae presents a lumen which can be injected for some of its length. For the most part, however, it remains as the ligamentum aortae (5) (Glenny, 1942b, 1943) which may or may not maintain its anterior connection with the pulmonary artery (7).

As has already been noted in an earlier paper (Glenny, 1943) the left ligamentum botalli almost or completely atrophies after the left radix aortae anastomoses with the left pulmonary (6th aortic) arch during middle embryogeny (the time of anastomosis varies in different species of birds). The right ligamentum botalli (6), therefore, alone remains as the vestige of the distal portion of the embryonic 6th aortic arch. This vestige lies along the ventral or ventro-lateral face of the right radix and generally maintains its proximal and distal connections.

The subclavian arteries (9) give rise to the coracoid major (10), axillary (11), intercostal (12), and two pectoral (13) arteries in order. The coracoid major (10) gives rise to a short sterno-tracheal (24) artery, and the axillary artery (11) sends off the coracoid minor (25) artery. The intercostal artery branches to form the

[1]Contributions from the Department of Zoology, University of Toronto.
[2]Formerly Assistant, Department of Zoology, University of Toronto. Now on Active Service, U. S. Army.

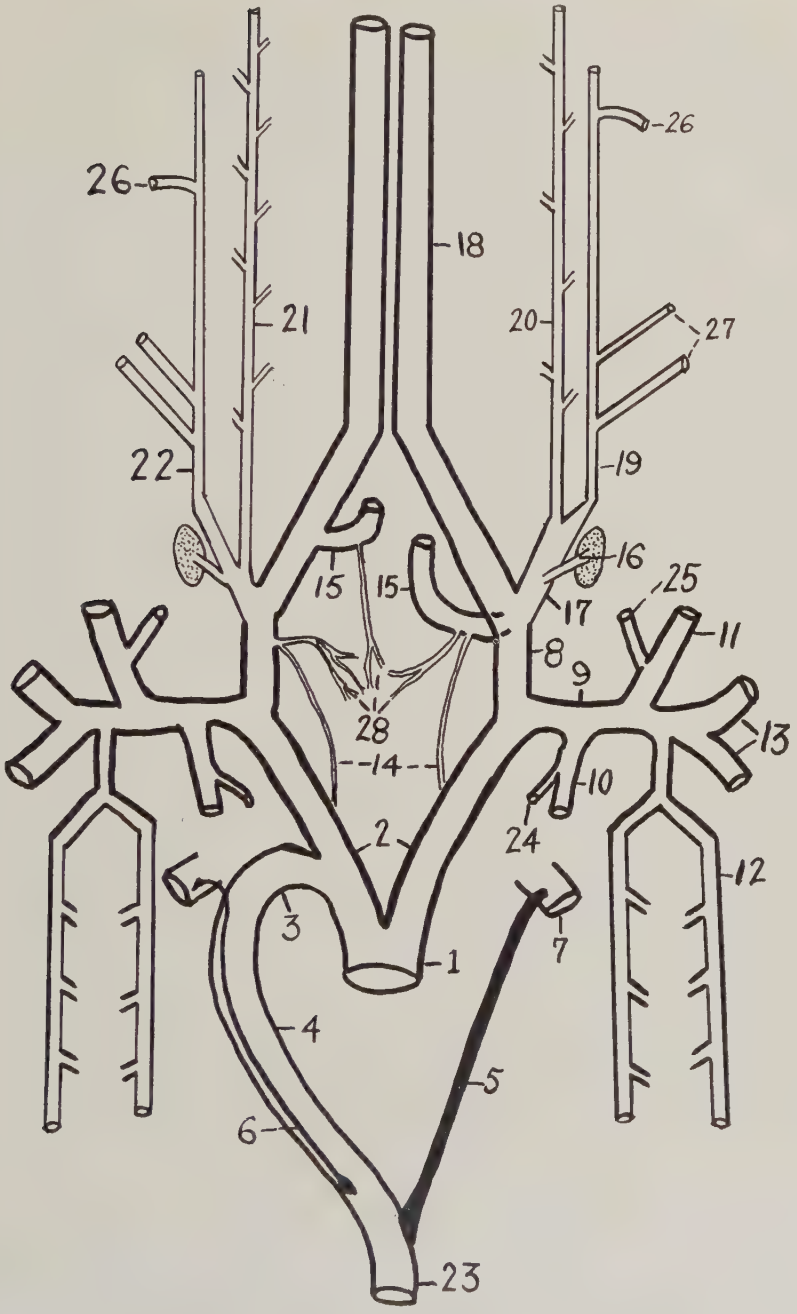

FIG. 1. Diagrammatic representation of the arrangement of arteries in the neck and thorax of *Spheniscus demersus* (Linné). Ventral view.

Key to Abbreviations of Fig. 1: 1, aortic root; 2, innominate arteries; 3, right systemic arch; 4, right radix aortae; 5, ligamentum aortae; 6, ligamentum botalli; 7, pulmonary artery; 8, common carotid artery; 9, subclavian artery; 10, coracoid major artery; 11, axillary artery; 12, intercostal artery; 13, pectoral arteries; 14, ductus shawi; 15, vertebral arteries; 16, thyroid artery; 17, superficial cervical artery (root); 18, internal carotid artery; 19, dorso-lateral cervical artery; 20, ventro-lateral cervical artery; 21, ascending-oesophageal artery; 22, dorso-lateral cervical artery; 23, dorsal aorta; 24, sterno-tracheal artery; 25, coracoid minor artery; 26, subscapular artery; 27, basi-cervical arteries; 28, tracheo-oesophageal arteries.

ventral and lateral rami. The ventral intercostal usually lies along or near the line of articulation between the ribs and sternum, while the lateral intercostal lies more dorsally (midway) along the inner surface of the ribs.

Anteriorly, the common carotid arteries (8) give rise to the thyroid (16), vertebral (15), internal carotid (18), and superficial cervical arteries. The thyroid arteries arise in the region of the carotid junction at which point the common carotid divides to form the internal carotid, vertebral, and superficial cervical arteries. The ductus shawi arises either from the common carotid or from the vertebral artery near its origin on the common carotid. Both left and right ductus shawi pass posteriorly, dorsal to the heart, sending off branches to the trachea, syrinx, oesophagus, and fascia of the thorax dorsal to the heart. The superficial cervical root divides into two smaller branches, a ventro-lateral branch which supplies the lymphatic glands and musculature on the left side, and the oesophagus, lymphatics, and musculature on the right side of the neck; and a more dorsal vessel which sends off several branches to the base of the neck (27), and a subscapular artery (26) before passing anteriorly to supply the cervical musculature. Both left and right internal carotid arteries (18) enter the hypapophysial canal and the condition is referred to as bicarotidinae normales (Garrod). As these vessels pass anteriorly they send off small segmental arteries and finally divide to form the several branches of the internal and external carotid arteries in the region of the head.

In *Eudyptes crestatus*, the left radix aortae remains as the ligamentum aortae (Glenny, 1943). The distal portion of the right 6th aortic arch presents a small lumen for about three-fourths of its length (may be due to immaturity of the specimen) while the rest remains as the occluded vestige.

Pygoscelis papua presents the same basic pattern as *Eudyptes* with but slight differences. The distal portion of the left radix aortae remains patent for most of its length. The right ductus botalli becomes atrophied and remains as the ligamentum botalli.

Although one specimen was but four days old, *Spheniscus demersus* presents a similar arrangement to *Eudyptes*. In each of the three specimens studied, the distal portion of the left radix aortae and right ductus botalli remain as ligaments.

The arrangement of these arteries in *Spheniscus mendiculus* is the same as in the other species studied. The distal portion of the right 6th aortic arch remains as a ductus botalli (probably a juvenile specimen), while the left radix becomes atrophied and persists as the ligamentum aortae.

It is readily seen that the species of Penguins studied show the same basic arrangement-pattern of neck and thoracic arteries, and that all of these present at least ligamentous vestiges of the left radix aortae and right ductus arteriosus. It may also be reasoned that, since a lumen is found to be present in at least two specimens, atrophy of the left radix and right ductus botalli probably occurs only during the latter part of their embryonic development.

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STUDIES IN THE BIOLOGY OF THE LEECH[1]

VII. A New Method of Staining Nervous Tissue

JOHN A. MILLER,
Department of Zoology and Entomology,
The Ohio State University,
Columbus, Ohio

The technique presented in this paper employs certain elements of the original Golgi method, combined with the working principle of the reduced silver method of Cajol. The accompanying illustrations demonstrate how effectively this technique differentiates the histological as well as the cytological details of the nervous system of the leech.[1] This method has in common with that of Golgi's the useful character of staining only some of the neurons. The stained portions are impregnated with the reduced silver compound showing clearly their structure and pattern. The nerve cells and their processes are black against a light blue background. Muscle or connective tissue cells, where appearing in the same field, are tinted red. If a counter stain is used color variations will be noted.

Miller's Method, Variants A and B

DETAILS OF PROCEDURE

1. *Relaxing.*

   The leech was placed in a shallow dish containing a 0.1 per cent chloretone solution to which had been added a pinch of protoletic enzyme. Caroid was found to be satisfactory. This latter, while not absolutely necessary, materially aided in disposing of the copious mucous secreted by the organism. After five minutes in the chloretone solution, there was added drop by drop, a saturated solution of the same until the leech was completely relaxed. It was then placed in a wax bottom dissecting pan. Here the leech was pinned to normal size and received the first application of the killing and fixing agent.

2. *Killing and Fixing.*

   A solution of 10 per cent formalin was used as a killing and fixing medium. The usual time of fixation was twenty-four hours. The animal was then washed thoroughly in tap water and in several changes of distilled water.

3. The leech was dissected at this point. A ventral strip of body wall was frequently left attached for orientation. A completely dissected nerve trunk was pinned on a strip of heavy paper bent to form a bow.

4. The tissue was then immersed in 3 per cent potassium dichromate for two weeks, then

5. Rinsed in several changes of distilled water.

6. The tissue was then placed in 1 per cent solution of silver nitrate; after a precipitate formed the tissue was transferred to a fresh solution of 1 per cent silver nitrate for 1 week.

7. Rinsed in several changes of distilled water.

[1] *Haemopis marmoratis* (Say).

8. *Dehydration.*

In the dehydration of material for celloidin imbedding it was necessary to insure absolute removal of all water. The following procedure proved to be adequate for parts of the nervous system of small sections of the animal. Beginning with 30 per cent alcohol the material was carried through 50–70–80–95–100 per cent alcohol for a minimum of two hours each. Two changes of two hours each in absolute alcohol-ether completed the process.

9. *Infiltration and Embedding.*

Following dehydration the tissue was placed in 10 per cent celloidin for eight hours and left overnight in 15 per cent celloidin. The material to be mounted was supported by a block of hardened celloidin and oriented within a mould formed by surrounding the fiber cutting block with gum paper. The cutting block mould was then filled with 15 per cent celloidin; the tissue oriented and hardened under a bell jar. Chloroform was used to complete the gardening process. When completely hardened the block was placed in thin cedar wood oil where it remained until sectioned. (In the procedure outlined above the block of tissue did not exceed one centimeter in length.)

10. Sections were cut to desired thickness. (Cedar wood oil was used in preference to alcohol during the cutting process.)

11. Sections were placed in thin cedar wood oil, where they were kept until ready to proceed with the next step. Sections were kept serially by separates. At this point two alternative procedures were followed.

VARIANT A

12A. Sections gradually hydrated and placed in

13A. Six per cent silver nitrate for four days (in the dark).

14A. Washed in several changes of distilled water.

15A. Reduced in the following mixture for 24 hours: (In the dark.)

Hydroquinone	2.0 g.
Neutral formalin	20.0 cc.
Water (distilled)	200.0 cc.

16A. Washed in several changes of distilled water.

17A. (Optional). Tone in 0.2 per cent gold chloride, 30 minutes.

18A. Washed in distilled water.

19A. Fixed in 5 per cent hypo-sulphite of soda, 30 seconds.

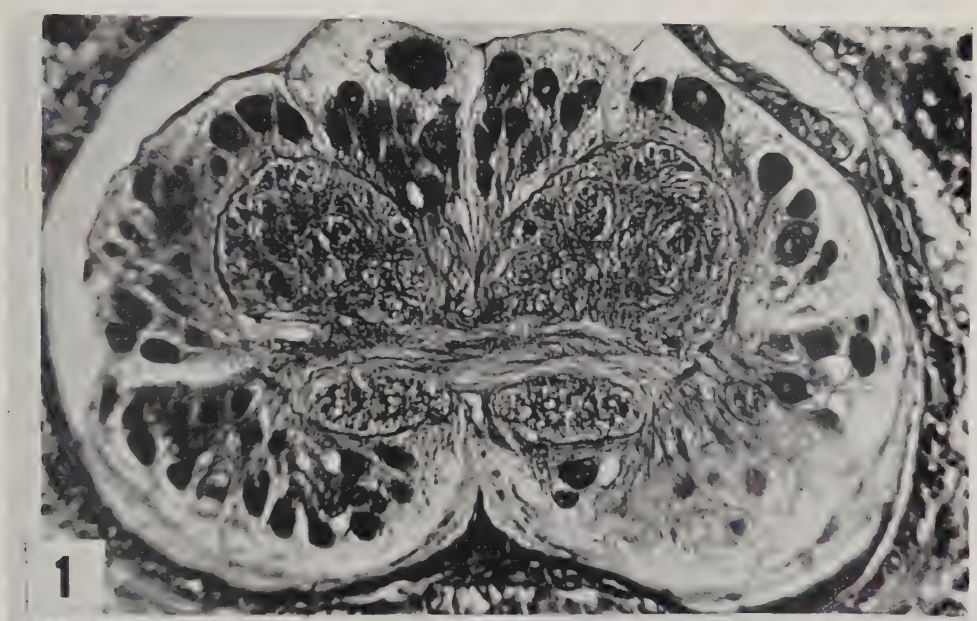
20A. Washed in distilled water.

21A. (Optional). Counter stain at this point if desired.

22A. Dehydrate, clear, mount in clarite. (Follow standard procedures which will vary according to type of counter stain used.)

EXPLANATION OF PLATE I

FIG. 1. Photomicrograph—Method A. Cross-section through a ganglion.
FIG. 2. Photomicrograph—Method A. Frontal section through a ganglion.
FIG. 3. Photomicrograph—Method A. Longitudinal section through the caudal ganglion.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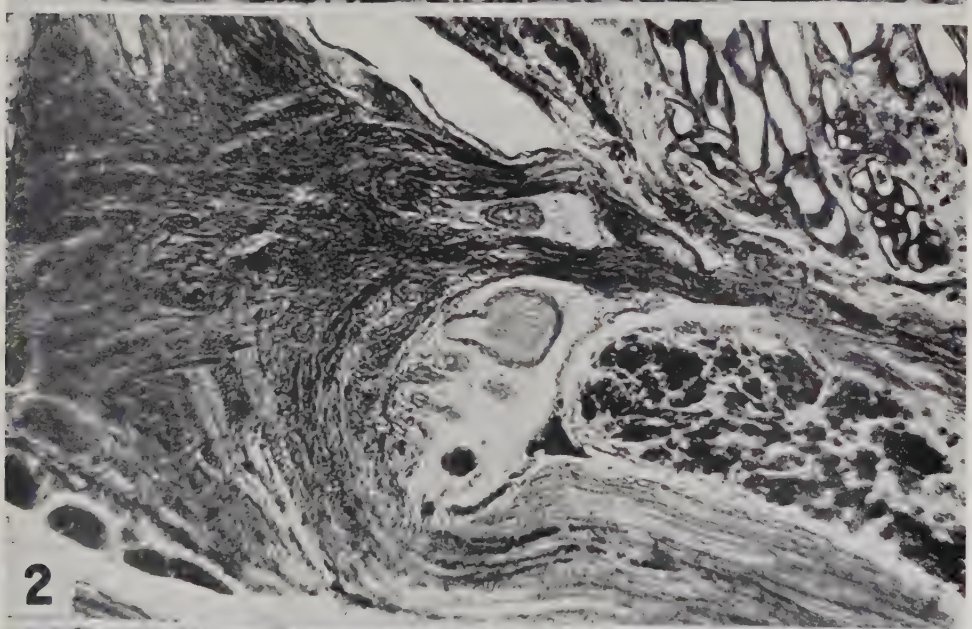
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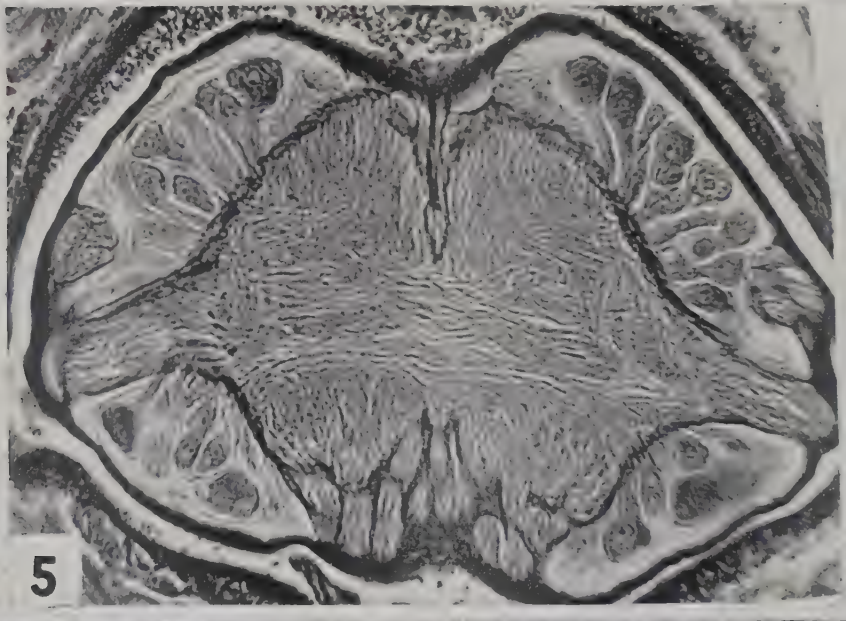
3

4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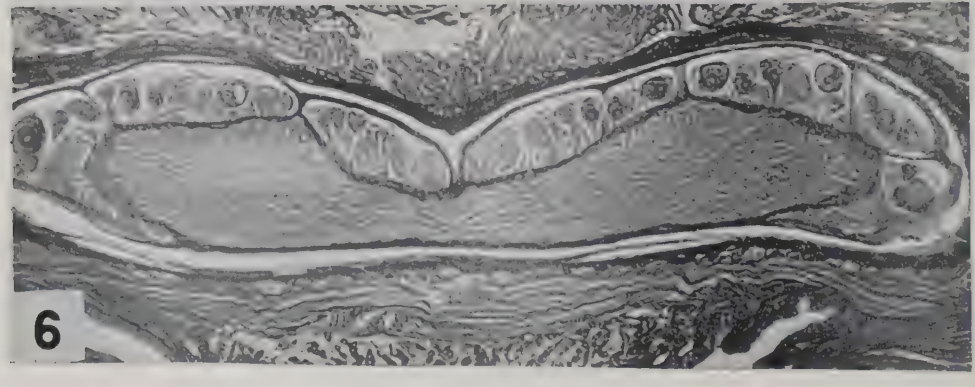
6

VARIANT B

12B. Sections from cedar wood oil were gradually hydrated and placed in
13B. 20 per cent silver nitrate solution 60–90 minutes.
14B. Washed quickly in distilled water and placed in
15B. Ammoniated silver nitrate, 3 minutes.

The above solution was prepared by adding concentrated aqua ammonia, drop by drop, to 20 per cent silver nitrate solution until the precipitate is almost dissolved. The mixture was then filtered. (The ammoniated silver nitrate must be freshly prepared and can be used only once.)

16B. Washed quickly in distilled water.
17B. Sections were placed in 10 per cent formalin one minute.
18B. Washed in several changes of distilled water.
19B. Toned in 2.0 per cent gold chloride 10 minutes.
20B. Washed in distilled water.
21B. (Optional procedure.) Reduce in 2.0 per cent oxalic acid + 1 cc. of formalin per 100 cc. of solution, 20 seconds.
22B. Washed in distilled water.
23B. Fixed in 5.0 per cent of hypo-sulphite of soda, 2 minutes.
24B. Washed in distilled water.
25B. (Optional.) Counter stain at this point if desired.
26B. Dehydrate, clear, mount in clarite. (Follow standard procedures which will vary according to type of counter stain used.)

Counter staining was successfully employed following either of the above procedures. Mayer's acid hematoxylin and eosin or haemalum gave good cellular differentiation. Mallory's phosphotungstic acid hematoxylin was very effective following either of the above variations. Follow standard procedures for counter staining and subsequent treatment.

Method A produced the best material for histological study, particularly noted in the longitudinal and frontal sections.

Method B was especially useful in cytological study, being particularly valuable in the study of ganglion cells.

The writer is preparing a manuscript of "Modifications in Neurological Microtechnique," as applied to leech material. This paper will appear in an early issue of this Journal.

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EXPLANATION OF PLATE II

FIG. 4. Photomicrograph—Method B. Cross-section through a nerve cord.
FIG. 5. Photomicrograph—Method B. Cross-section through a ganglion.
FIG. 6. Photomicrograph—Method B. Cross-section through the dorsal cephalization.

PERMANENT PRESTAINING IN BOTANICAL MICROTECHNIC[1]

EUGENE B. WITTLAKE,
The Ohio State University, Columbus, Ohio

One of the many problems in botanical microtechnic is the retainment of safranin at the proper intensity and brilliance when counterstaining with fast green FCF or any of the commonly used counterstains. Especially is it difficult when attempting to stain plant tissues previously treated with hydrofluoric acid.

The term "permanent" is used here for the lack of a better word and to distinguish this type of staining from ordinary procedures. The most common prestaining is a process of staining bulk material so that it can be easily seen in the paraffin block or ribbon. In permanent prestaining, the bulk material is stained once and the stain used in prestaining becomes the primary stain of the finished preparation.

In this instance a specific method was sought, which would be suitable for the staining of bluegrass leaves in transverse section. By using this type of prestaining, several days may be added to the dehydration process; however, time is saved from imbedding to the finished preparation.

The preparation of bluegrass leaves by this technic is relatively simple but certain procedures must be adhered to if the desired results are to be obtained. First, the leaves are cut transversely with a sharp razor blade into one-eighth inch lengths. If they are cut any longer uneven penetration of the dye is unavoidable. Also, siliceous compounds will not be uniformly removed when treated with hydrofluoric acid.

OUTLINE OF PROCEDURE

1. Place material in formal-acetic-alcohol (using 70 per cent ethyl alcohol), or Bouin's Fluid, and by means of a vacuum pump or an apparatus similar to Wittlake's (2) vacuum apparatus, pump at 600 mm. mercury for 12 hours.
2. Rinse quickly in distilled water and transfer to commercial hydrofluoric acid (48 per cent)[2], 120 hours.
3. Remove material from the hydrofluoric acid and wash in running tap water for one hour.
4. Transfer material to Johansen's (1) 50 per cent Tertiary Butyl Alcohol. Pump one hour at 600 mm. mercury.
5. Stain in Safranin Y[3] made up according to Johansen's (1) procedure of preparing Safranin O with methocellosolve. Stain from 96 to 120 hours.
6. Dehydrate by Johansen's (1) Tertiary Butyl Alcohol method up to 100 per cent at intervals of two hours.
7. Transfer to 10, 25, 50, 70, 85, 95, 100 per cent toluene series made up in tertiary butyl alcohol at two-hour intervals.
8. Transfer to equal parts of xylene and toluene, and finally to 100 per cent xylene. Change at two-hour intervals.
9. Place specimen bottle in the imbedding oven for one-half hour, allowing the xylene to warm up. Infiltrate in a good grade of rubber paraffin by adding paraffin to the xylene at several three-hour intervals and pouring off half the volume of the mixture

[1]Papers from the Department of Botany, The Ohio State University, No. 463.

[2]The hydrofluoric acid used is obtainable from J. T. Baker Chemical Co., Phillipsburg, New Jersey, in ¼-lb. (113.4g) paraffin container at a concentration of 48 per cent.

[3]The Safranin Y used was manufactured by the Coleman and Bell Co., Norwood, Ohio, certification No. C S-7.

each time until no odor of xylene can be detected. If a vacuum is used in the infiltrating process only four or five changes will be necessary before all the xylene is removed.

10. Section material at 10 microns and remove paraffin from slide with xylene, which will occur within about 5 minutes.
11. Transfer to equal parts of xylene and absolute alcohol for 45 seconds, agitating the slide constantly.
12. Transfer to absolute ethyl alcohol for 45 seconds and continue agitation.
13. Counterstain with Johansen's Fast Green FCF[3] 30 to 45 seconds and agitate.
14. Transfer slides to Johansen's (1) Fast Green Rinse for one minute with vigorous agitation. (This is made up of one part xylene, one part clove oil and one part 100 per cent ethyl alcohol.)
15. Clear in synthetic methyl salicylate two minutes.
16. Complete in two changes of xylene at two-minute intervals.
17. Mount in xylene balsam or clarite.

Acceptable finished preparations, from tissues fixed in formal-acetic-alcohol, were obtained, showing very little plazmolysis and both the primary stain and the counterstain were up to standard as to brilliance and intensity. However, Bouin's Fluid proved to be the preferred fixative for this particular leaf tissue. When using either of these fixatives, fixation was accomplished in a twelve-hour interval under vacuum at 600 mm. mercury.

Since it is almost impossible to cut satisfactorily the leaves of many grasses without first removing the silica, a commercial grade of hydrofluoric acid was used so that the material could be sectioned easily in paraffin. Of course, all containers in which this acid is used should be first paraffined on the inside, as well as the cork used for the container. A standard 50 cc. wide-mouthed bottle is sufficient for most material. Care should be taken not to breathe the fumes of this acid. When the material becomes translucent to opaque in appearance, it is ready to be removed from the acid. This is usually from 96 to 120 hours. All material in this experiment was treated for 120 hours.

In this staining method, the proper staining time of the bulk material was determined by selecting the material which showed after prestaining, a minimum of diffusion of the dye into the mesophyl of the leaf from the vascular strands. The bulk material selected in this way turned out to be the same material that was acceptable when carried through the above schedule to the finished preparation. A decrease or increase in the timing of the counterstain altered the acceptability of the finished slide. When a counterstain time was secured with bulk material of these characteristics and showed the proper balance between the safranin and the fast green in the finished preparation, this counterstain time was used as the standard time. When bulk material was selected which showed a great amount of diffusion of the dye into the mesophyl, it was impossible to vary the counterstain time sufficiently to produce a satisfactory finished preparation. The same thing was true in the case of bulk material that was understained.

In the safranin-fast green combination, the balance between the two stains changes even with the particular tissue being stained; hence alterations in the timing of stains in most of the general staining schedules is necessary. A safranin-fast green combination which is not up to standard can be detected by definite gradations of red to purple and blue to green from parts of tissue which should stain a brilliant red to parts of tissue which stain a brilliant green color. In other words, a well differentiated preparation should show definite areas of green and red.

The writer has found that the range in time intervals between strictly alcoholic

[3]The Fast Green FCF used was manufactured by the National Aniline and Chemical Co., Inc., New York, New York, certification No. NG f-4, dye content 91 per cent.

safranin and alcoholic fast green is much longer than the staining time interval between Johansen's (1) Metho-cellosolve safranin and Johansen's Metho-cellosolve fast green. However, when the proper time interval is obtained with Johansen's stains, they yield excellent results. Although, these time intervals between Johansen's safranin and fast green are more difficult to balance properly without obtaining blue and purple gradations of color, it would seem that a beginner would have more success with alcoholic safranin-fast green schedules.

In this particular procedure the writer has used only a part of Johansen's Tertiary Butyl Alcohol Dehydration Method. When 100 per cent tertiary butyl alcohol was reached, the material was transferred to 10 per cent toluene made up in 100 per cent tertiary butyl alcohol. This was done to avoid the use of paraffin oil in Johansen's schedule. Paraffin oil is extremely hard to extract from plant tissues once it gains entrance. The author, as well as several of his associates, have tried Johansen's Tertiary Butyl Alcohol Dehydration Method with no success. When ready to cut infiltrated material where there is a trace of paraffin oil left in the tissues, it is almost impossible to get a satisfactory ribbon.

Toluene was used with 100 per cent tertiary butyl alcohol and after extended use of this particular combination of liquids, it was found that a minimum of hardening of tissues resulted. The lack of brittleness was very apparent in contrast to material run through a long series of xylenes and ethyl alcohols.

Although this staining procedure was worked out specifically for bluegrass leaves it has been successfully used on other material. Many other tissues not treated with hydrofluoric acid were also used with the result that safranin was retained easily and to a very high intensity. Another observation is that material permanently prestained by this method can be left in the dehydration alcohols much longer than in regular staining schedules.

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(2) **Wittlake, E. B.** 1942. An efficient vacuum apparatus for microtechnic. Ohio Journal of Science, 42: 65–69.

So You Want to Be a Chemist

"A chemist is more or less a human being, though not always behaving like one, who is going to come to be welcomed in more and more fields of business activity and industry as people learn more about him and as he in turn learns more about people."—so Dr. Coith defines (describes) a chemist. With similar frankness and "shop-talk language" he develops his theme: The Work of the Chemist in Standards, Research, Plant Development and Products Service; he then discusses The Kind of Chemists Industry Wants, The Kind of Industries Chemists Want, and The Chemist in Wartime. The discussion is general enough to hold one's interest, but specific enough to give a helpful point of view on pertinent questions by a successful industrial chemist. This is a very helpful book to have on every teacher's book shelf where it will be handy to loan to the young person interested in *industrial* chemistry. But to be fair to the youth and to the field of chemistry, such counsellors should also have a companion book to present the work of the chemist in universities and in the great research foundations; those areas unfortunately are not treated in this book.—*A. B. Garrett.*

So You Want to Be a Chemist, Herbert Coith. 128 pages. McGraw-Hill Book Company, New York. 1943.

Taxidermy

This new book on taxidermy, although small, is sufficient to satisfy the needs of amateurs and most teachers. The book is carefully written and nicely illustrated. Detailed directions are given specifically for the mounting of a deer head, a fish, bird, wildcat, squirrel, tortoise, horned toad and a crayfish. A list of tools and necessary materials is given with suggestions for possible substitutions.—*G. W. B.*

Taxidermy, by Leon L. Pray. 91 pp., 45 illustrations. Macmillan Company, New York. 1943. $1.49.

FRESHWATER CHLOROPHYCEAE AND XANTHOPHYCEAE FROM PUERTO RICO

L. H. TIFFANY AND M. E. BRITTON,
Northwestern University,
Evanston, Ill.

It was the plan of the late Dr. Marshall Avery Howe of the New York Botanical Garden to publish comprehensive surveys of the freshwater algae of Puerto Rico. Some of these have already appeared. The analysis of the samples of algae collected by the Norwegian algologist, N. Wille, during the last week of December, 1914, and the first three months of 1915, were to have formed a part of these reports. The collection of Professor Wille, submitted to us by Dr. Howe some ten years ago, has now been quite thoroughly explored for recognizable Chlorophyceae and Xanthophyceae. Preliminary reports have been made by Wille (1915) and Tiffany (1936). In the latter, one genus and fourteen species were described as new, and the descriptions of three others were emended.[1]

This paper lists four species and varieties of Xanthophyceae and 228 species and varieties of Chlorophyceae. The latter group includes 35 species and varieties previously listed for Puerto Rico (Lagerheim, 1887; Moebius, 1888), but not found by the present writers; and 11 species and varieties previously listed by the above named and also appearing in Wille's collections.[2] It has seemed best to include these older records here, and names have been changed accordingly to conform with modern synonomy.

The writers express their appreciation to Dr. E. N. Transeau and to Dr. C. E. Taft, of the Ohio State University, for their generous assistance in the identification of certain Zygnemataceae and Desmidiaceae; and to the staff of the New York Botanical Garden for the opportunity of studying this valuable collection. Translation of Wille's field notes was made by Dr. Howe.

XANTHOPHYCEAE

HETEROCOCCALES

Ophiocytiaceae

Ophiocytium capitatum Wolle
In pool near park, Santurce, Dec. 25; in brook near the Experiment Station, Rio Piedras, Dec. 28.

O. parvulum (Perty) A. Braun
In pool near park, Santurce, Dec. 25, Feb. 3; east of Humacao, Jan. 23; in pool about four kilometers north of Mayaguez, Feb. 24.

Botryococcaceae

Centritractus belonophorus Lemm.
In pool near park, Santurce, Dec. 25.

HETEROTRICHALES

Tribonemataceae

Tribonema bombycinum var. **tenue** (Hazen) Tiffany
In ditch, Jayuya, Mar. 15.

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[1]These algae are indicated in the systematic listing by prefacing an asterisk to each name.

[2]Many of the species recorded by Moebius are too uncertain to be recognized. All of Lagerheim's records of Chlorophyceae are included here, except *Desmidium baileyi* (Ralfs) Nordst. var. *quadrangulatum*, *Staurastrum quadrangulare* Breb. var. *attenuatum* Nordst., and *Cosmarium meneghini* Breb. *f.* Delp, which we have not been able to place accurately.

CHLOROPHYCEAE

VOLVOCALES

Phacotaceae

Phacotus lenticularis (Ehr.) Stein
West of Humacao, Jan. 21.

Volvocaceae

Gonium pectorale Muell.
Caguas, Jan. 16.

Pandorina morum Bory
In a pool near the park, Santurce, Dec. 25; in pool west of Humacao, Jan. 21.

TETRASPORALES

Palmellaceae

Gloeocystis ampla Kuetz.
Caguas, Jan. 17; west of Humacao, Jan. 22; east of Humacao, Jan. 23; in pool near Borinquen Park, Santurce, Feb. 3; in pool about 4 kilometers north of Mayaguez, Feb. 24; in pool between Hatillo and Arecibo, Feb. 27; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

Sphaerocystis schroeteri Chodat
In stream about 5 kilometers east of Coamo, Jan. 8; east of Humacao, Jan. 23; in pool near Borinquen Park, Santurce, Feb. 3; in pool about 4 kilometers north of Mayaguez, Feb. 24.

(?) **Urococcus insignis** (Hass.) Kuetz.
On water plants, east of Humacao, Jan. 23. Identified only by size and the character of the stratified gelatinous sheath. The red coloration characteristic of the species was not evident in the preserved material.

Tetrasporaceae

Schizochlamys gelatinosa A. Braun
At Maricao, Feb. 21.

Tetraspora gelatinosa (Vauch.) Desv.
In stream about 5 kilometers east of Coamo, Jan. 8.

T. lubrica (Roth) Ag.
In stream about 5 kilometers east of Coamo, Jan. 8; in brook west of Humacao, Jan. 21.

ULOTRICHALES

Ulotrichaceae

Binuclearia tatrana Wittr.
In river at Utuado, Mar. 5.

Stichococcus flaccidus (Kuetz.) Gay
Reported by Wille but not seen by present writers.
On palm roots in ditch south of Mayaguez, Feb. 11; on wood on way to Monte Montoso, Maricao, Feb. 13; on earth between Hato Arriba and Arecibo, Mar. 1.

Ulothrix aequalis Kuetz.
In river at Utuado, Mar. 5.

U. zonata (Weber & Mohr) Kuetz.
In Turabo River, Caguas, Jan. 17; in ditch on way to the Playa, Fajardo, Feb. 27; in ditch south of Mayaguez, Feb. 11; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

Microsporaceae

Microspora tumidula Hazen
In brook on way to San Lorenzo, Jan. 18; in brook west of Humacao, Dec. 21; in stream west of Humacao, Jan. 22.

M. willeana Lag.
In stream about 5 kilometers east of Coamo, Jan. 8; in river at Utuado, Mar. 5.

Chaetophoraceae

Chlorotylium cataractum Kuetz.
In stream about 5 kilometers east of Coamo, Jan. 8; in Coamo River, about 5 kilometers south of Coamo Springs, Jan. 10.

***Cloniophora capitellata** Tiffany
Near reservoir west of Experiment Station, Rio Piedras, Dec. 31; in brook on the road

northward from Maricao, Feb. 20; in water basin west of Experiment Station, Rio Piedras, Mar. 23; on stone in river north of Maricao, Feb. 22.

***C. willei** Tiffany
On the dam by water reservoir, Rio Piedras, Dec. 31.

Protoderma viride Kuetz.
In pool, Jayuya, Mar. 15; on Oedogonium in water basin west of Experiment Station, Rio Piedras, Mar. 23.

Stigeoclonium attenuatum (Hazen) Collins
In water basin west of Experiment Station, Rio Piedras, Mar. 23.

S. nanum (Dillw.) Kuetz.
On water plants in ditch south of Mayaguez, Feb. 11.

S. stagnatile (Hazen) Collins
In stream east of Humacao, Jan. 23; on stone in stream, Humacao, Jan. 24; on gutter stone, Mayaguez, Feb. 25.

S. tenue (Ag.) Kuetz.
On bark of a stick in water east of Humacao, Jan. 23.

Protococcaceae

Pleurococcus vulgaris Naeg. non Menegh.
On old bark in railroad station, Naguabo, Jan. 25; on bark in shady wood, Maricao, Feb. 21.

Coleochaetaceae

***Coleochaete disjuncta** Tiffany
In pool near Borinquen Park, Santurce, Feb. 3.

C. irregularis Pringsh.
In pool about 4 kilometers north of Mayaguez, Feb. 24.

C. pulvinata A. Braun
In pool about 4 kilometers north of Mayaguez, Feb. 24.

C. scutata Breb.
In pool near park, Santurce, Dec. 25; on water plants near reservoir west of Experiment Station, Rio Piedras, Jan. 8; in a stream about 5 kilometers east of Coamo, Jan. 17; on stems of Potamogeton in Turabo River, Caguas, Jan. 23; on water plants in a stream east of Humacao, Jan. 23; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

Trentepohliaceae

Cephaleuros virescens Kunze
On leaves, Coamo Springs, Jan. 14; on water plants in stream west of Humacao, Jan. 22; on leaves near Laguna Tortuguero, Feb. 5.

Gongrosira viridis Kuetz.
In stream about 5 kilometers east of Coamo, Jan. 8.

Leptosira mediciana Borzi
On roots in woods, Coamo Springs, Jan. 12. Identified by Wille.

Phycopeltis epiphyton Mill. (*Phyllactidium tropicum* Moebius) Moebius (1888)
On tree, Coamo Springs, Jan. 10; on citrus leaves near La Juanita, Feb. 9 (collected by E. G. Britton); on palm leaf at La Juanita, Feb. 9.

Trentepohlia aurea (L.) Mart.
On reservoir wall west of Experiment Station, Rio Piedras, Jan. 2; on old wood, Hacienda Catalina, Palmar, Jan. 29; on concrete fountain and bark in woods on way to Monte Montoso, Maricao, Feb. 13; on bark near "Campo," Maricao, Feb. 19; on bark about 5 kilometers north of Utuado, Mar. 8; on bark, Arroyo de los Corchos, Mar. 13.

T. elongata (Zeller) DeToni
In a brook near Rio Piedras, Dec. 27; in brook near Experiment Station, Rio Piedras, Dec. 28.

***T. santurcensis** Tiffany
On palm bark in park, Santurce, Dec. 24.

***T. willei** (Tiffany) Printz (*Nylandera willei* Tiffany)
On leaves north of Maricao, Feb. 22.

Cladophoraceae

Cladophora crispata (Roth) Kuetz.
Moebius (1888). Collected at Cabo and in river and brook at Coamo.

C. glomerata (L.) Kuetz.
Moebius (1888). Collected on rocks in Marillos River at Cayey.
Generally distributed in streams and rivers. About 5 kilometers east of Coamo, Jan. 8; near Coamo Springs, Jan. 11; Caguas, Jan. 16; on way to San Lorenzo, Jan. 18; water basin west of Experiment Station, Rio Piedras, Mar. 23. The species shows considerable variation in appearance and shape of cells, but to try to recognize separate varieties seems unwise.

Pithophora mooreana Collins
In water reservoir, Rio Piedras, Dec. 28; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

P. oedogonia (Mont.) Wittr.
In pool between Hatillo and Arecibo, Feb. 27.

P. varia Wille
In water reservoir, Rio Piedras, Dec. 28; in pool about 4 kilometers north of Mayaguez, Feb. 24; in pool, Jayuya, Mar. 15; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

Rhizoclonium fontanum Kuetz. (*R. fontinale* Wolle)
Moebius (1888). Collected in Morillos River, Cayey.
In brook, Hacienda Catalina, Palmar, Jan. 29; in a cement water-holder, Coral Veijo, 12 kilometers north of Ponce, Mar. 12.

R. hieroglyphicum (Ag.) Kuetz.
Generally distributed in pools, brooks and rivers. Near Rio Piedras, Dec. 27, 28; west of Humacao, Jan. 22; in Laguna Tortuguero, Feb. 5; about 4 kilometers north of Mayaguez, Feb. 24; about 5 kilometers north of Utuado, Mar. 8; in ditch between Utuado and Adjuntas, Mar. 10; Jayuya, Mar. 15; water basin west of Experiment Station, Rio Piedras, Mar. 23.

OEDOGONIALES

Oedogoniaceae

Bulbochaete elatior Pringsh.
On water plants in Turabo River, Caguas, Jan. 17; stream east of Humacao, Jan. 23.

B. intermedia DeBary
On water plants in river east of Humacao, Jan. 23.

***Oedocladium operculatum** Tiffany
On ground, Juan Martin, Jan. 28; on earth in garden near Sabana Grande, Mayaguez, Feb. 9.

Oedogonium abbreviatum (Hirn) Tiffany
On water plants in brook near Rio Piedras, Dec. 24; in Coamo River about 5 kilometers south of Coamo Springs, Jan. 10; in pool between Hatillo and Arecibo, Feb. 27.

***O. brittoni** Tiffany
In Coamo River near Coamo Springs, Jan. 11, Mar. 20.

O. cardiacum var. **carbonicum** Wittr.
In a stream about 5 kilometers east of Coamo, Jan. 8.

O. crispum (Hass.) Wittr.
On water plants in brook west of Humacao, Jan. 21.

O. cyathigerum Wittr.
In water basin west of Experiment Station, Rio Piedras, Mar. 23.

O. decipiens var. **dissimile** (Hirn) Tiffany
On water plants in Turabo River, Caguas, Jan. 17; in pool near Borinquen Park, Santurce, Feb. 3.

O. exospirale Tiffany
On roots of *Eichornia crassipes* in river, Caguas, Jan. 16.

***O. figuratum** Tiffany
On roots of *Eichornia crassipes* and other water plants in river, Caguas, Jan. 16; on water plants in brook west of Humacao, Jan. 21; in pool between Hatillo and Arecibo, Feb. 27.

O. flexuosum Hirn
On roots of water plants in river at Utuado, Mar. 5; in pool by river about 5 kilometers north of Utuado, Mar. 8.

O. foveolatum Wittr.
In brook on way to San Lorenzo, Jan. 18; in pool between Hatillo and Arecibo, Feb. 27; in ditch along the road, about 12 kilometers north of Utuado, Mar. 6.

O. gracilius (Wittr.) Tiffany
In water basin west of Experiment Station, Rio Piedras, Mar. 23.

O. gracillimum Wittr. & Lund.
On water plants in brook west of Humacao, Jan. 21.

O. grande Kuetz.
On water plants in brook west of Humacao, Jan. 21.

***O. howardii** G. S. West
In stream about 5 kilometers east of Coamo, Jan. 8, 16; in pool near Borinquen Park, Santurce, Feb. 3; in pool between Hatillo and Arecibo, Feb. 27; on rocks, Jayuya, Mar. 15; in Coamo River, Mar. 20.

***O. howei** Tiffany
In pool between Hatillo and Arecibo, Feb. 27.

O. hystricinum Transeau & Tiffany
In pool near Borinquen Park, Santurce, Feb. 3.

O. illinoiense Transeau
On roots of *Eichornia crassipes* in river, Caguas, Jan. 16.

O. inconspicuum Hirn
In pool near park, Santurce, Dec. 25; in a pool near Borinquen Park, Santurce, Feb. 3.

O. intermedium Wittr.
In ditch 12 kilometers north of Utuado, Mar. 6.

O. inversum Wittr.
Laguna Guanica, Mar. 17.

O. kurzii G. Zeller
In pool by river, 5 kilometers north of Utuado, Mar. 8.

O. laetevirens Wittr.
In pool between Hatillo and Arecibo, Feb. 27.

***O. lageniforme** Hirn
In water reservoir west of Experiment Station, Rio Piedras, Jan. 2.

O. latiusculum Tiffany
In water reservoir west of Experiment Station, Rio Piedras, Jan. 2; in Coamo River, about 5 kilometers south of Coamo Springs, Jan. 10.

O. latviense (Tiffany) Tiffany
On water plants near reservoir west of Experiment Station, Rio Piedras, Dec. 31; on water plants by bridge, Caguas, Jan. 16; in stream west of Humacao, Jan. 22.

O. lemmermannii Tiffany
In stream about 5 kilometers east of Coamo, Jan. 28.

O. macrandrium var. **hohenackerii** (Wittr.) Tiffany
In pool between Hatillo and Arecibo, Feb. 27.

O. macrandrium var. **propinquum** (Wittr.) Hirn
In brook on way to San Lorenzo, Jan. 18; in pool between Hatillo and Arecibo, Feb. 27.

O. monile Berk. & Harv.
In pool near Mayaguez, Feb. 24.

O. nanum Wittr.
On water plants in pool between Hatillo and Arecibo, Feb. 27.

O. obesum Wittr.
In pool near park, Santurce, Dec. 25; in brook on way to San Lorenzo, Jan. 18; in brook west of Humacao, Jan. 21.

O. obtruncatum Wittr.
On water plants by bridge, Caguas, Jan. 16; in ditch south of Mayaguez, Feb. 11; on water plants in pool between Hatillo and Arecibo, Feb. 27; in pool, Jayuya, Mar. 15.

O. paulense Nordst. & Hirn
In pool near Borinquen Park, Santurce, Feb. 3.

O. perfectum (Hirn) Tiffany
In ditch south of Mayaguez, Feb. 11.

O. pringsheimii Cramer
On water plants in brook west of Humacao, Jan. 21; in pool between Arecibo and Hatillo, Feb. 27; in river at Utuado, Mar. 5.

***O. rugulosum** var. **rotundatum** (Hirn) Tiffany.
In pool near Borinquen Park, Santurce, Feb. 3; in pool between Hatillo and Arecibo, Feb. 27.

***O. santurcense** Tiffany
In pool near Borinquen Park, Santurce, Feb. 3.

O. senegalense (Nordst.) Tiffany
In pool near Borinquen Park, Santurce, Feb. 3.

***O. subareolatum** Tiffany
In pool near Borinquen Park, Santurce, Feb. 3.

O. wolleanum Wittr.
In water reservoir, Rio Piedras, Dec. 28.

O. wyliei Tiffany
On water plants in brook west of Humacao, Jan. 21.

ULVALES

Schizomeridaceae

Schizomeris leibleinii Kuetz.
Generally distributed, often on water plants and stones in pools, ditches, streams and reservoirs. Near Rio Piedras, Dec. 27, 31; 5 kilometers east of Coamo, Jan. 8; Caguas, Jan. 16; on way to San Lorenzo, Jan. 18; west of Humacao, Jan. 21; east of Humacao, Jan. 23; Farjardo, Jan. 27; Hacienda Catalina, Palmar, Jan. 29; South of Mayaguez, Feb. 11; 4 kilometers north of Mayaguez, Feb. 24; Mayaguez, Feb. 25; between Hatillo and Arecibo, Feb. 27; Utuado, Mar. 5; Ponce, Mar. 12; Jayuya, Mar. 15.
In some collections there appeared a Schizomeris whose general habit was somewhat unlike that of the species above, but until more data are available, it does not seem desirable to attempt a separation.

SCHIZOGONIALES

Schizogoniaceae

Schizogonium murale Kuetz.
On rocks between Utuado and Adjuntas, Mar. 10.

CHLOROCOCCALES

Hydrodictyaceae

Pediastrum duplex Meyen
In pool near park, Santurce, Dec. 25; in a stream about 5 kilometers east of Coamo, Jan. 8; in pool near Borinquen Park, Santurce, Feb. 3.

P. tetras (Ehr.) Ralfs (*P. ehrenbergii* A. Br.)
Lagerheim (1887). Collected at Fajardo and Caguas.
Moebius (1888).
In stream about 5 kilometers east of Coamo, Jan. 8; on water plants by bridge, Caguas, Jan. 16; on water plants in Turabo River, Caguas, Jan. 17; in stream east of Humacao, Jan. 23; in pool near Borinquen Park, Santurce, Feb. 3; in Coamo River, Mar. 20; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

P. tetras var. **tetraodon** (Corda) Hansgirg
In a stream about 5 kilometers east of Coamo, Jan. 8.

Sorastrum americanum (Bohlin) Schmidle
In pool near the park, Santurce, Dec. 25; in stream about 5 kilometers east of Coamo, Jan. 8; on water plants in Turabo River, Caguas, Jan. 17; in pool near Borinquen Park, Santurce, Feb. 3.

S. bidentatum Reinsch
Lagerheim (1887). Collected at Fajardo.

S. spinulosum Naeg.
In a stream about 5 kilometers east of Coamo, Jan. 8; on water plants in Turabo River, Caguas, Jan. 17; in pool near Borinquen Park, Santurce, Feb. 3.

Coelastraceae

Coelastrum cambricum Archer
In a pool near park, Santurce, Dec. 25; on water plants in Turabo River, Caguas, Jan. 17.

C. microporum Naeg.
In pool near park, Santurce, Dec. 25; on water plants in Turabo River, Jan. 17; in brook on way to San Lorenzo, Jan. 18; Caguas, Jan. 19; in pool near Borinquen Park, Santurce, Feb. 3; in Laguna Tortuguero, Feb. 5; in Coamo River, Mar. 23; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

C. morus var. **capense** Fritsch.
In rock depression in river near Maricao, Feb. 15; on rocks between Utuado and Adjuntas, Mar. 10.

C. proboscideum Bohlin
In river near Maricao, Feb. 15.

Oocystaceae

Ankistrodesmus falcatus (Corda) Ralfs (*Raphidium polymorphum* Fresen.)
Lagerheim (1887). Collected at Fajardo.

Dimorphococcus lunatus A. Braun
In a pool near park, Santurce, Dec. 25; on water plants in Turabo River, Caguas, Jan. 17; in pool near Borinquen Park, Santurce, Feb. 3.

Gloeotaenium loitlesbergerianum Hansgirg
In Laguna Tortuguero, Feb. 5.

Kirchneriella lunaris (Kirchner) Moebius
In Laguna Tortuguero, Feb. 5.

Nephrocytium obesum West
On water plants in Turabo River, Caguas, Jan. 17.

Oocystis solitaria Wittr.
Lagerheim (1887). Collected at Fajardo.
Moebius (1888).

Selenastrum bibraianum Reinsch
On water plants in Turabo River, Jan. 17.

S. bibraianum var. **gracile** (Reinsch) Tiffany & Ahlstrom
On water plants in Turabo River, Caguas, Jan. 17.

Tetraedron minimum (A. Br.) Hansgirg
In stream about 5 kilometers east of Coamo, Jan. 8; on water plants by bridge, Caguas, Jan. 16; on water plants in Turabo River, Caguas, Jan. 17; on water plants in brook west of Humacao, Jan. 21; in rock depression in river near Maricao, Feb. 15; in pool about 4 kilometers north of Mayaguez, Feb. 24; on rocks on way to Jayuya, Mar. 15.

T. minimum f. tetralobulatum Reinsch
In stream about 5 kilometers east of Coamo, Jan. 8; in rock depression in river near Maricao, Feb. 15; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

T. muticum (A. Br.) Hansgirg
In pool about 4 kilometers north of Mayaguez, Feb. 24.

T. pentaedricum W. & G. S. West
On water plants in Turabo River, Caguas, Jan. 17.

T. regulare Kuetz.
In pool near park, Santurce, Dec. 25; in rock depression in river near Maricao, Feb. 15.

T. regulare var. **bifurcatum** Wille (*Polyedrium tetraedricum* var. *bifurcatum* Wille)
Lagerheim (1887). Collected at Fajardo.

T. regulare var. **torsum** Turner
In a pool near the park, Santurce, Dec. 25.

T. trigonum (Naeg.) Hansgirg
In pool about 4 kilometers north of Mayaguez, Feb. 24.

Scenedesmaceae

Scenedesmus abundans (Kirchner) Chodat
In a pool near park, Santurce, Dec. 25, Feb. 3.

S. acuminatus (Lag.) Chodat
In pool near Borinquen Park, Santurce, Feb. 3.

S. acutiformis Schroeder
In pool near park, Santurce, Dec. 25; in Turabo River, Caguas, Jan. 17; in stream east of Humacao, Jan. 23; in pool near Borinquen Park, Santurce, Feb. 3; in pool near river, 5 kilometers north of Utuado, Mar. 8.

S. arcuatus var. **platydisca** G. M. Smith
On water plants in Turabo River, Caguas, Jan. 17; in pool about 4 kilometers north of Mayaguez, Feb. 24.

S. armatus (Chodat) G. M. Smith
In pool about 4 kilometers north of Mayaguez, Feb. 24.

S. armatus var. **bicaudatus** (Guglielmetti) Chodat
In brook on way to San Lorenzo, Jan. 18.

S. armatus var. **exaculeatus** Chodat
In stream about 5 kilometers east of Coamo, Jan. 8; on water plants east of Humacao, Jan. 23; in river, Fajardo, Jan. 26; in Laguna Tortuguero, Feb. 5; in water basin west of Experiment Station, Rio Piedras, Mar. 23.

S. bijuga (Turp.) Lagerheim
In pool near park, Santurce, Dec. 25; in water reservoir, Rio Piedras, Dec. 28; in stream about 5 kilometers east of Coamo, Jan. 8; in pool near Borinquen Park, Santurce, Feb. 3; in pool about 4 kilometers north of Mayaguez, Feb. 24; in pool by river, about 5 kilometers north of Utuado, Mar. 8.

S. bijuga var. **alternans** (Reinsch) Borge
Lagerheim (1887). Collected at Fajardo.
In a stream about 5 kilometers east of Coamo, Jan. 8; in a river near Maricao, Feb. 15.

S. brasiliensis Bohlin
In pool near park, Santurce, Dec. 25; on water plants in Turabo River, Caguas, Jan. 17; on water plants in river, Fajardo, Jan. 26; on stone in river, Fajardo, Jan. 27; in pool near Borinquen Park, Santurce, Feb. 3; in rock depression in river near Maricao, Feb. 15; in pool by river, about 5 kilometers north of Utuado, Mar. 8.

S. brasiliensis var. **norvegicus** Printz
In pool near Borinquen Park, Santurce, Feb. 3.

S. dimorphus (Turpin) Kuetz.
In stream about 5 kilometers east of Coamo, Jan. 8; in rock depression in river near Maricao, Feb. 15; in pool by river about 5 kilometers north of Utuado, Mar. 8; on rocks on way to Jayuya, Mar. 15; in pool, Jayuya, Mar. 15; in swamp, Jayuya, Mar. 15; in pool, Jayuya, Mar. 15.

S. hystrix Lagerheim
Lagerheim (1887). Collected at Fajardo and Caguas.

S. incrassatulus var. **mononae** G. M. Smith
In stream about 5 kilometers east of Coamo, Jan. 8; in rock depression in river near Maricao, Feb. 15.

S. obliquus (Turp.) Kuetzing
In pool near park, Santurce, Dec. 25; in stream about 5 kilometers east of Coamo, Jan. 8; on water plants in Turabo River, Caguas, Jan. 17; in pool near Borinquen Park, Santurce, Feb. 3; in pool by river about 5 kilometers north of Utuado, Mar. 8.

S. quadricauda (Turp.) Breb.
In pool near Borinquen Park, Santurce, Dec. 25, Feb. 3; in stream about 5 kilometers east of Coamo, Jan. 8; on water plants in Turabo River, Caguas, Jan. 17; in Laguna Tortuguero, Feb. 5; in pool about 4 kilometers north of Mayaguez, Feb. 24; in pool between Hatillo and Arecibo, Feb. 27; among water plants in pool, Jayuya, Mar. 15.

S. quadricauda var. **maximus** W. & G. S. West
In Laguna Tortuguero, Feb. 5.

S. quadricauda var. **quadrispina** (Chodat) Smith
In pool near Borinquen Park, Santurce, Dec. 25; in stream about 5 kilometers east of Coamo, Jan. 8; in pool about 4 kilometers north of Mayaguez, Feb. 24.

SIPHONALES

Vaucheriaceae

Vaucheria sessilis (Vauch.) DC.
In ditch between Utuado and Adjuntas, Mar. 10.

ZYGNEMATALES

Zygnemataceae

Mougeotia calcarea (Cleve) Wittrock
In Laguna Tortuguero, Feb. 5.

M. globulispora Jao
In stream about 5 kilometers east of Coamo, Jan. 8.

M. tumidula Transeau
In ditch near Laguna Joyuda, Mayaguez, Feb. 18.

***Pleurodiscus borinquenae** Tiffany
In river near Hacienda Catalina, Palmar, Jan. 29, 31; in Laguna Tortuguero, Feb. 5; near Maricao, Feb. 13; near Jayuya, Mar. 15.

Sirogonium sticticum (Engl. Bot.) Kuetz.
On moist earth by brook west of Humacao, Jan. 22.

Spirogyra daedalea Lagerheim
In a stream about 5 kilometers east of Coamo, Jan. 8.

S. decimina (Mueller) Kuetz.
In pool near park, Santurce, Dec. 25; in stream about 5 kilometers east of Coamo, Jan. 8; in alluvial slime in Coamo River, about 5 kilometers south of Coamo Springs, Jan. 10; in ditch, Humacao, Jan. 20 ; in pool about 4 kilometers north of Mayaguez, Feb. 24; in river at Utuado, Mar. 5; in pool by river, about 5 kilometers north of Utuado, Mar. 8.

S. discreta Transeau
In a stream about 5 kilometers east of Coamo, Jan. 8.

S. emilianensis Bonhomme
In brook on way to San Lorenzo, Jan. 8; in stream west of Humacao, Jan. 22; in Rio Grande, near Sabana Grande, Feb. 9; in Coamo River by Coamo Springs, Mar. 19.

S. farlowii Transeau
In a stream about 5 kilometers east of Coamo, Jan. 8; in pool 5 kilometers north of Utuado, Mar. 8.

S. fluviatilis Hilse
In stream west of Humacao, Jan. 22; in pool about 4 kilometers north of Mayaguez, Feb. 24.

***S. hatillensis** Transeau
In pool between Hatillo and Arecibo, Feb. 27.

S. hyalina Cleve
In brook on way to San Lorenzo, Jan. 18; in ditch south of Mayaguez, Feb. 11.

S. inflata (Vauch.) Rabenhorst
In stream about 5 kilometers east of Coamo, Jan. 8.

S. majuscula Kuetzing
In pool between Hatillo and Arecibo, Feb. 27.

S. minor (Schmidle) Transeau
In stream about 5 kilometers east of Coamo, Jan. 8.

S. neglecta (Hassall) Kuetzing
In Coamo River near Coamo Springs, Jan. 11.

S. nitida (Dillw.) Link
In brook, Hacienda Holm, Mayaguez, Feb. 17.

***S. quadrilaminata** Jao
In a stream about 5 kilometers east of Coamo, Jan. 8.

S. schmidtii W. & G. S. West
In pool about 4 kilometers north of Mayaguez, Feb. 24.

S. subrecticulata Fritsch
In water reservoir, Rio Piedras, Dec. 28; in stream about 5 kilometers east of Coamo, Jan. 8; in ditch south of Mayaguez, Feb. 11; in river north from Maricao, Feb. 22.

S. triplicata (Collins) Transeau
In Coamo River near Coamo Springs, Jan. 11; in brook on way to San Lorenzo, Jan. 18.

S. tropica (W. & G. S. West) Transeau
In stream about 5 kilometers east of Coamo, Jan. 8; in Coamo River near Coamo Springs, Feb. 11; in brook on way to San Lorenzo, Jan. 18; in ditch south of Mayaguez, Feb. 11; in pool between Hatillo and Arecibo, Feb. 27; in pool by river, about 5 kilometers north of Utuado, Mar. 8.

S. varians (Hass.) Kuetzing
In pool by river, about 5 kilometers north of Utuado, Mar. 8.

S. weberi Kuetzing
In stream about 5 kilometers east of Coamo, Jan. 8.

Mesotaeniaceae

Gonatozygon monotaenium DeBary
In water reservoir west of Experiment Station, Rio Piedras, Jan. 2.

Desmidiaceae

Arthrodesmus subulatus f. americana (Turn.) W. & G. S. West (*A. incus* var. *americanus* Turn.)
Lagerheim (1887). Collected at Fajardo.

Closterium dianae Ehr.
Lagerheim (1887). Collected at Fajardo.

C. ehrenbergii Menegh.
On water plants in brook near Rio Piedras, Dec. 27.

C. lanceolatum Kuetz.
In Coamo River near Coamo Springs, Jan. 11.

C. leibleinii Kuetz.
Lagerheim (1887). Collected at Fajardo.
In water reservoir west of Experiment Station, Rio Piedras, Jan. 2; on water plants in Turabo River, Caguas, Jan. 17.

C. moniliferum (Bory) Ehr.
On water plants in brook near Rio Piedras, Dec. 27; by water reservoir west of Experiment Station, Rio Piedras, Dec. 31, Jan. 2; on water plants by bridge, Caguas, Jan. 16; in river, Caguas, Jan. 16; in brook on way to San Lorenzo, Jan. 18; in brook west of Humacao, Jan. 21, 22.

C. parvulum Naeg.
In a pool near park, Santurce, Dec. 25; on water plants in brook near Rio Piedras, Dec. 27, 28; on water plants in river, Caguas, Jan. 16.

C. rostratum Ehr.
In brook on way to San Lorenzo, Jan. 18.

C. tumidum Johnson
In pool near park, Santurce, Dec. 25.

C. turgidum var. **giganteum** Nordst.
Lagerheim (1887). Collected at Caguas.

Cosmarium arctoum var. **tatricum** Racib.
Lagerheim (1887). Collected at Fajardo.

C. biauritum Nordst.
Lagerheim (1887). Collected at Fajardo.

C. bireme Nordst.
Lagerheim (1887). Collected at Fajardo.

C. circulare Reinsch
On water plants in brook and near reservoir near Rio Piedras, Dec. 27, 31; in brook west of Humacao, Jan. 21.

C. circulare f. **minor** W. & G. S. West
On water plants near reservoir west of Experiment Station, Rio Piedras, Dec. 31.

C. contractum Kirch.
In Turabo River, Caguas, Jan. 17.

C. cucumis (Corda) Ralfs (*Pleurotaeniopsis cucumis* Lagerheim)
Lagerheim (1887). Collected at Fajardo.

C. granatum Breb.
Lagerheim (1887). Collected at Caguas.
In brook and water reservoir near Experiment Station, Rio Piedras, Dec. 27, 28, 31, Jan. 2; in stream about 5 kilometers east of Coamo, Jan. 8; on water plants by bridge, Caguas, Jan. 16; on water plants in Turabo River, Caguas, Jan. 17; in brook on way to San Lorenzo, Jan. 18.

C. humile var. **substriatum** (Nordst.) Schmidle
On water plants in Turabo River, Caguas, Jan. 17.

C. laeve Rab.
In stream 5 kilometers east of Coamo, Jan. 8.

C. lundellii var. **ellipticum** West
In stream about 5 kilometers east of Coamo, Jan. 8.

C. margaritatum (Lund.) Roy and Biss. (*C. latum* var. *margaritatum* Lund.)
Lagerheim (1887). Collected at Fajardo and Caguas.

C. meneghini Breb.
In pool near park, Santurce, Dec. 25.

C. meneghini f. **latiuscula** Jacobs
Lagerheim (1887). Collected at Caguas.

C. moniliforme (Turp.) Ralfs
Lagerheim (1887). Collected at Fajardo and Caguas.

C. moniliforme f. **punctata** Lagerheim
Lagerheim (1887). Collected at Fajardo.

C. obtusatum Schmidle
In stream about 5 kilometers east of Coamo, Jan. 8.

C. phaseolus Breb.
Lagerheim (1887). Collected at Fajardo.

C. pokornyanum (Grun.) W. & G. S. West (*Euastrum angustatum* Wittr.)
Lagerheim (1887). Collected at Fajardo.

C. portianum Arch.
On water plants in Turabo River, Caguas, Jan. 17.

C. pseudoconnatum Nordst. (*Pleurotaeniopsis pseudoconnatus* (Nordst.) Lag.)
Lagerheim (1887). Collected at Fajardo.
On water plants in Turabo River, Caguas, Jan. 17.

C. pseudoexiguum Racib. (*Pleurotaeniopsis pseudoexigua* (Racib.) Lag.)
Lagerheim (1887). Collected at Fajardo.

C. pseudonitudulum Nordst.
In a stream about 5 kilometers east of Coamo, Jan. 8.

C. punctulatum Breb.
On water plants in Turabo River, Caguas, Jan. 17.

C. regnesii Reinsch
Lagerheim (1887). Collected at Fajardo.

C. subcostatum Nordst.
Near reservoir west of Experiment Station, Rio Piedras, Dec. 31; in stream about 5 kilometers east of Coamo, Jan. 8; in Coamo River about 5 kilometers south of Coamo Springs, Jan. 10; in Coamo River near Coamo Springs, Jan. 11; on water plants in brook west of Humacao, Jan. 21; in stream west of Humacao, Jan. 22.

C. subtumidum Nordst.
Lagerheim (1887). Collected at Fajardo.
On water plants in Turabo River, Caguas, Jan. 17.

C. tinctum Ralfs
Lagerheim (1887). Collected at Fajardo.

C. zygomorphicum Taft
West of Experiment Station, Rio Piedras, Dec. 31; in river, Caguas, Jan. 16; on water plants in Turabo River, Caguas, Jan. 17; in brook on way to San Lorenzo, Jan. 18.

Desmidium swartzii var. **quadrangulatum** (Ralfs) Roy
In pool near park, Santurce, Dec. 25, Feb. 3.

Euastrum attenuatum Wolle
Lagerheim (1887). Collected at Fajardo.

E. bidentatum Naeg.
On water plants in Turabo River, Caguas, Jan. 17.

E. denticulatum (Kirch.) Gay
Lagerheim (1887). Collected at Fajardo.

E. divaricatum Lund.
Lagerheim (1887). Collected at Fajardo.

E. elegans (Breb.) Kuetz.
Lagerheim (1887). Collected at Fajardo.

E. gemmatum Breb.
Lagerheim (1887). Collected at Fajardo.

E. sibiricum Boldt.
Lagerheim (1887). Collected at Fajardo.

E. subintegrum Nordst.
Lagerheim (1887). Collected at Fajardo.

E. sublobatum Breb. (*Cosmarium sublobatum* (Breb.) Arch.)
Lagerheim (1887). Collected at Fajardo.

Micrasterias sol (Ehr.) Kuetz.
On water plants in Turabo River, Caguas, Jan. 17.

Onychonema laeve var. **latum** W. & G. S. West
In stream about 5 kilometers east of Coamo, Jan. 8.

O. laeve var. **micracanthum** Nordst.
Lagerheim (1887). Collected at Fajardo.
On water plants in Turabo River, Caguas, Jan. 17.

Penium margaritaceum (Ehr.) Breb.
In stream west of Humacao, Jan. 22.

Pleurotaenium coronatum (Breb.) Rab.
In pool near park, Santurce, Dec. 25.

P. indicum (Grun.) Lund. (*P. indicum* var. *crassius* Lagerheim)
Lagerheim (1887). Collected at Fajardo.

P. maximum (Reinsch) Lund.
In pool near park, Santurce, Dec. 25; on water plants in Turabo River, Caguas, Jan. 17.

P. trabecula (Ehr.) Naeg.
On water plants in Turabo River, Caguas, Jan. 17; in brook west of Humacao, Jan. 21.

Sphaerozosma granulatum Roy & Biss. (*S. excavatum* f. *javanica* Nordst.)
Lagerheim (1887). Collected at Fajardo.
On water plants in Turabo River, Caguas, Jan. 17

Staurastrum bacillare Breb.
Lagerheim (1887). Collected at Fajardo.

S. denticulatum (Naeg.) Arch.
On water plants in Turabo River, Caguas, Jan. 17.

S. dickiei var. **circulare** Turn.
On water plants in Turabo River, Caguas, Jan. 17.

S. polymorphum Breb.
Lagerheim (1887). Collected at Fajardo.

S. rotula Nordst.
Lagerheim (1887). Collected at Fajardo.

S. trifidum var. **glabrum** Lagerheim
Lagerheim (1887). Collected at Fajardo.

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Introduction to Biophysics

Under this title the author has brought together a discussion of a number of important topics in biophysics. As the chapter headings indicate, the viewpoint is definitely slanted towards medicine and human physiology: I. Biophysically Active X-Rays. II. Applied Radioactivity. II. Biophysical Characteristics of the Eye. IV. Emission and Absorption of Biophysically Active Light. V. The Structure and Properties of Surfaces and Membranes. VI. The Biophysical Problem of Nerve Conduction. VII. Auditory Biophysics. VIII. The Compound Microscope; The Electron Microscope. The reader whose primary interest is in plant physiology, other than human, physiology, or bacteriology will turn from a reading of the book with an unsatisfied feeling, as only few applications to such branches of biology are mentioned. Within his chosen topical limits, however, the author has managed to present the current state of knowledge in this borderline domain of science with admirable concision. The section on the compound microscope should be required reading for all biologists. Perhaps the most surprising omission is the complete absence of any consideration of radiant energy from the quantum viewpoint. There are general author and subject indices, and a working bibliography at the end of each chapter.—*B. S. Meyer.*

An Introduction to Biophysics, by Otto Stuhlman, Jr. 375 pp. John Wiley & Sons, New York. 1943. $4.00.

Medical and Zoological Microtechnic

The encyclopedic method of presenting the subject has been adopted by the author. However, the book is not large, such as the German Encyclopedias of Ehrlich and Krause. The author has selected what he considers the more important technics from a voluminous literature, and presented it in a very concise form. In many instances it was not possible to include all details which might be desired. To overcome this disadvantage references are given in their appropriate places and not collected in a large bibliography. It will serve as a quick, easy reference book on a host of technics used in the study of animal tissues.—*G. W. B.*

Microscopic Technique in Biology and Medicine, by E. V. Cowdry. 206 pp. The Williams and Wilkins Company, Baltimore, Md., 1943. $4.00.